DOCUMENT 00102

LIST OF DRAWINGS
12/97

1.1 SUMMARY

This document lists the drawings for the project pursuant to contract clause "DFARS 252.236-7001, Contract Drawings, Maps and Specifications."

1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

DWG NO.	EFD DWG NO.	NAVFAC DWG NO.	TITLE
T-1	493891	4393891	TITLE SHEET - DRAWING INDEX
T-2	493892	4393892	VICINITY AND LOCATION MAPS - DRAWING INDEX (CONT.)
C-1	493893	4393893	NOTES, ABBREVIATIONS AND LEGEND
C-2	493894	4393894	NEW PIER 2 LAYOUT PLAN
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C-4	493896	4393896	DEMOLITION PLAN (1 OF 5)
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C-6	493898	4393898	DEMOLITION PLAN (3 OF 5)
C-7	493899	4393899	DEMOLITION PLAN (4 OF 5)
C-8	493900	4393900	DEMOLITION PLAN (5 OF 5)
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C-10	493902	4393902	SITE DEMOLITION PLAN (1 OF 2)
C-11	493903	4393903	SITE DEMOLITION PLAN (2 OF 2)
C-12	493904	4393904	NEW SITE LAYOUT PLAN (1 OF 2)
C-13	493905	4393905	NEW SITE LAYOUT PLAN (2 OF 2)
C-14	493906	4393906	NEW SITE GRADING PLAN (1 OF 2)
C-15	493907	4393907	NEW SITE GRADING PLAN (2 OF 2)
C-16	493908	4393908	NEW SITE UTILITY PLAN (1 OF 2)
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C-20	493912	4393912	Z-86 DEMOLITION SITE PLAN
C-21	493913	4393913	EXISTING UTILITY STRUCTURE DATA
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C-23	493915	4393915	PAVEMENT DETAILS
C-24	493916	4393916	MISCELLANEOUS DETAILS
C-25	493917	4393917	OILY WASTE/WASTE OIL (OWWO) PROFILE
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C-27	493919	4393919	DREDGING PLAN
C-28	493920	4393920	DREDGING PLAN
C-29	493921	4393921	DREDGING PLAN
C-30	493922	4393922	DREDGING PLAN
C-31	493923	4393923	DREDGING PLAN
C-32	493924	4393924	DREDGING PLAN
C-33	493925	4393925	DREDGING DETAILS
CS-1	493926	4393926	SIDE SCAN SONAR AND MAGNETOMETER SURVEY (1 OF 6)
CS-2	493927	4393927	SIDE SCAN SONAR AND MAGNETOMETER SURVEY (2 OF 6)
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DM-1	493942	4393942	STEAM LINE DEMOLITION SITE PLAN
ER-1	493943	4393943	ASBESTOS NOTES AND DETAIL
ER-2	493944	4393944	ASBESTOS ABATEMENT BUILDING Z-86
ER-3	493945	4393945	ASBESTOS ABATEMENT BUILDING Z-86
ER-4	493946	4393946	ASBESTOS ABATEMENT BUILDING Z-86
ER-5	493947	4393947	ASBESTOS REMOVAL BUILDING Z-86
ER-6	493948	4393948	ASBESTOS ABATEMENT BUILDING Z-357
ER-7	493949	4393949	ASBESTOS ABATEMENT BUILDING Z-357
ER-8	493950	4393950	ASBESTOS ABATEMENT BUILDING Z-357
ER-9	493951	4393951	PCB LIGHT BALLAST REMOVAL BLDG. Z-86
ER-10	493952	4393952	PCB LIGHT BALLAST REMOVAL BLDG. Z-86
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ER-12	493954	4393954	PCB LIGHT BALLAST REMOVAL BLDG. Z-357
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ER-14	493956	4393956	RCRA METALS CONTAINING PAINT REMOVAL BLDG. Z-86
ER-15	493957	4393957	RCRA METALS CONTAINING PAINT REMOVAL BLDG. Z-357
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B-2	493960	4393960	BORINGS 3 AND 4
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S-3	493972	4393972	PARTIAL PLAN - PIER 2 (BENTS 21 - 40)
S-4	493973	4393973	PARTIAL PLAN - PIER 2 (BENTS 41 - 60)
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S-7	493976	4393976	LATERAL PIER SECTION AT BOLLARD PLATFORMS
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S-10	493979	4393979	DETAIL - LOWER DECK EDGE AT SHIP POWER STATION
S-11	493980	4393980	DETAIL - LOWER DECK EDGE AT SHIP POWER STATION
S-12	493981	4393981	DETAIL - LOWER DECK EDGE AT INSHORE END
S-13	493982	4393982	LONGITUDINAL SECTION AT VEHICLE RAMP
S-14	493983	4393983	LONGITUDINAL SECTION AT LOWER DECK ENTRANCE
S-15	493984	4393984	DETAILS - OFFSHORE END AND EXPANSION JOINTS
S-16	493985	4393985	OFFSHORE STAIRWELL AND SPLICE BOX ENCLOSURE DETAILS

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SA-1	493987	4393987	PRECAST, PRESTRESSED PILE DETAILS
SA-2	493988	4393988	PRECAST CONCRETE EDGE CAP DETAILS
SA-3	493989	4393989	PRECAST CONCRETE PILE CAP LAYOUT PLAN
SA-4	493990	4393990	PRECAST CONCRETE PILE CAP DETAILS AND SECTIONS
SA-5	493991	4393991	PRECAST CONCRETE PILE CAP HAUNCH DETAILS
SA-6	493992	4393992	PILE CAP SHEAR KEY DETAILS
SA-7	493993	4393993	PRECAST CONCRETE BEAM DETAILS
SA-8	493994	4393994	PRECAST CONCRETE BEAM DETAILS
SA-9	493995	4393995	PRECAST CONCRETE BEAM AND EDGE PANEL DETAILS
SA-10	493996	4393996	LOWER DECK PRECAST CONCRETE SLAB LAYOUT PLAN
SA-11	493997	4393997	PRECAST CONCRETE SLAB DETAILS
SA-12	493998	4393998	PRECAST CONCRETE SLAB DETAILS
SA-13	493999	4393999	PRECAST CONCRETE SLAB OPENING - LIFT STATION DETAILS
SB-1	494000	4394000	EDGE CAP AND PILE CAP INSTALLATION DETAILS
SB-2	494001	4394001	EDGE BEAM INSTALLATION DETAILS
SB-3	494002	4394002	PIER END CLOSURE DETAILS
SB-4	494003	4394003	LOWER DECK CLOSURE DETAILS
SB-5	494004	4394004	LOWER DECK SLAB INSTALLATION DETAILS
SB-6	494005	4394005	BATTER PILE CAP AND SHEAR KEY DETAILS
SB-7	494006	4394006	LOWER DECK UTILITY CURB DETAILS
SB-8	494007	4394007	PIER-END CURB-MISC. LOWER DECK CONCRETE DETAILS
SB-9	494008	4394008	ELECTRICAL EQUIPMENT SUPPORT DETAILS
SB-10	494009	4394009	LIFT STATION INSTALLATION DETAILS
SB-11	494010	4394010	EDGE PANEL INSTALLATION - PIPE HANGER DETAILS
SC-1	494011	4394011	LOWER DECK PLANS
SC-2	494012	4394012	UPPER DECK PLANS
SC-3	494013	4394013	COLUMNS
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SC-5	494015	4394015	LOWER DECK ENCLOSURES
SC-6	494016	4394016	ENCLOSURE ELEVATIONS AND DETAILS
SC-7	494017	4394017	BOLLARD PLATFORMS
SC-8	494018	4394018	UPPER DECK BEAMS
SC-9	494019	4394019	UPPER DECK BEAMS
SC-10	494020	4394020	SECTIONS
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SC-13	494023	4394023	DETAILS
SC-14	494024	4394024	DETAILS
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SD-6	494030	4394030	RAIL FENDER FABRICATION DETAILS
SD-7	494031	4394031	FENDER SYSTEM DETAILS
SD-8	494032	4394032	LADDER AND FOAM-FILLED FENDER DETAILS
SD-9	494033	4394033	PIPE SUPPORT DETAILS
SD-10	494034	4394034	PIPE SUPPORT DETAILS
SD-11	494035	4394035	VEHICLE RAMP GATE DETAILS
SD-12	494036	4394036	CHAIN LINK FENCE PLANS AND DETAILS
SD-13	494037	4394037	SUBSTATION DOLLY ASSEMBLY DETAILS
SE-1	494038	4394038	RELIEVING PLATFORM - PARTIAL PLAN
SE-2	494039	4394039	RELIEVING PLATFORM - PARTIAL PLAN
SE-3	494040	4394040	RELIEVING PLATFORM - PARTIAL PLAN

DWG NO.	EFD DWG NO.	NAVFAC DWG NO.	TITLE
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SE-5	494042	4394042	RELIEVING PLATFORM - DETAILS
SE-6	494043	4394043	RELIEVING PLATFORM - DETAILS
SE-7	494044	4394044	RELIEVING PLATFORM - SECTIONS
SE-8	494045	4394045	RELIEVING PLATFORM - SECTIONS
SE-9	494046	4394046	RELIEVING PLATFORM - CORNER DETAILS
SE-10	494047	4394047	GUARD SHACK DETAILS
SE-11	494048	4394048	GUARD SHACK DETAILS
SF-1	494049	4394049	LHD MOORING ARRANGEMENTS
SF-2	494050	4394050	LHA MOORING ARRANGEMENTS
SF-3	494051	4394051	LPD / LSD MOORING ARRANGEMENTS
SF-4	494052	4394052	AOE-1 MOORING ARRANGEMENTS
SF-5	494053	4394053	AOE-6 MOORING ARRANGEMENTS
SF-6	494054	4394054	AO-177 MOORING ARRANGEMENTS
SF-7	494055	4394055	AO-187 MOORING ARRANGEMENTS
SF-8	494056	4394056	SURFACE COMBATANT MOORING ARRANGEMENTS
MU-1	494057	4394057	STEAM SITE PLAN
MU-2	494058	4394058	POL PLAN - SITE 1
MU-3	494059	4394059	POL PLAN - SITE 2
MU-4	494060	4394060	STEAM LINE PROFILE & POL SITE 2 PROFILE
MU-5	494061	4394061	SITE PLAN DETAILS - STEAM & POL
M-1	494062	4394062	PIER 2 PLAN (BENTS 1 - 40), STM & PW SYSTEMS
M-2	494063	4394063	PIER 2 PLAN (BENTS 40- 80), STM & PW SYSTEMS
M-3	494064	4394064	PIER 2 PLAN (BENTS 1 - 40), CHT + OW SYSTEMS
M-4	494065	4394065	PIER 2 PLAN (BENTS 40- 80), CHT + OW SYSTEMS
M-5	494066	4394066	STEAM PRESSURE REDUCING STATION PLAN
M-6	494067	4394067	STM/PW SERVICE POINT PLAN
M-7	494068	4394068	DFM/JP5 SERVICE POINT PLAN
M-8	494069	4394069	WATER, SANITARY, & OWWO SERVICE TO NEW PIER 2
M-9	494070	4394070	OW / CHT SERVICE POINT PLAN
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M-11	494072	4394072	SECTIONS
M-12	494073	4394073	DETAILS
EU-1	494074	4394074	LEGEND
EU-2	494075	4394075	PARTIAL 34.5KV SYSTEM ONE-LINE DIAGRAM
EU-3	494076	4394076	PIER 2 34.5KV ONE-LINE & GROUNDING DIAGRAM
EU-4	494077	4394077	CABLE AND CABLE WELL SCHEDULES
EU-5	494078	4394078	SITE PLAN 1
EU-6	494079	4394079	SITE PLAN 2
EU-7	494080	4394080	SITE PLAN 3
EU-8	494081	4394081	SITE PLAN 4
EU-9	494082	4394082	SITE PLAN 5
EU-10	494083	4394083	NW SWITCHING STATION SITE PLAN
EU-11	494084	4394084	NW SWITCHING BUS PLAN
EU-12	494085	4394085	NW SWITCHING STATION ONE-LINE DIAGRAM
EU-13	494086	4394086	NW SWITCHING STATION CONTROL BUILDING PLAN
EU-14	494087	4394087	TYPICAL NW BREAKER CONTROL DIAGRAM
EU-15	494088	4394088	NW SWITCHING STATION ELEVATIONS
EU-16	494089	4394089	NW SWITCHING STATION FOUNDATION PLANS AND DETAILS
EU-17	494090	4394090	BLDG. Z-86 AND Z-357 DEMOLITION PLANS
EU-18	494091	4394091	POWER MANHOLE EXPLODED VIEWS
EU-19	494092	4394092	COMMUNICATION MANHOLE EXPLODED VIEWS
EU-20	494093	4394093	MANHOLE DETAILS
EU-21	494094	4394094	MISCELLANEOUS SITE WORK DETAILS
E-1	494095	4394095	PIER CONDUIT PLAN - BENT 1 TO 20
E-2	494096	4394096	PIER CONDUIT PLAN - BENT 21 TO 40

DWG NO.	EFD DWG NO.	NAVFAC DWG NO.	TITLE
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E-4	494098	4394098	PIER CONDUIT PLAN - BENT 61 TO 80
E-5	494099	4394099	SHORE POWER SUBSTATION AREA - ENLARGED PLANS
E-6	494100	4394100	480V SHORE POWER SYSTEM CONNECTIONS - EAST STATIONS
E-7	494101	4394101	480V SHORE POWER SYSTEM CONNECTIONS - WEST STATIONS
E-8	494102	4394102	SECONDARY UNIT SUBSTATION ONE-LINE DIAGRAM
E-9	494103	4394103	SECONDARY UNIT SUBSTATION PLAN & ELEVATION
E-10	494104	4394104	SIMPLIFIED AC & DC SUBSTATION BREAKER CONTROL DIAGRAM
E-11	494105	4394105	SHORE POWER STATION DETAILS
E-12	494106	4394106	PIER INDUSTRAIL POWER ONE-LINE DIAGRAM
E-13	494107	4394107	PIER POWER AND LIGHTING PLAN - BENT 1 TO 10
E-14	494108	4394108	PIER POWER AND LIGHTING PLAN - BENT 10 TO 20
E-15	494109	4394109	PIER POWER AND LIGHTING PLAN - BENT 20 TO 30
E-16	494110	4394110	PIER POWER AND LIGHTING PLAN - BENT 30 TO 40
E-17	494111	4394111	PIER POWER AND LIGHTING PLAN - BENT 40 TO 50
E-18	494112	4394112	PIER POWER AND LIGHTING PLAN - BENT 50 TO 60
E-19	494113	4394113	PIER POWER AND LIGHTING PLAN - BENT 60 TO 70
E-20	494114	4394114	PIER POWER AND LIGHTING PLAN - BNET 70 TO 80
E-21	494115	4394115	CABLE TRAY PLANS
E-22	494116	4394116	CABLE ROOM PLANS
E-23	494117	4394117	EQUIPMENT ROOM PLANS AND ELEVATIONS
E-24	494118	4394118	PUMP STATION PLANS & DETAILS
E-25	494119	4394119	PUMP STATION CONTROL SYSTEM DIAGRAMS
E-26	494120	4394120	PIER CONDUIT DETAILS
E-27	494121	4394121	PIER PANELBOARD SCHEDULES
E-28	494122	4394122	PIER LIGHTING CONTACTOR PANELS
E-29	494123	4394123	LIGHTING FIXTURE SCHEDULE AND LIGHTING DETAILS
E-30	494124	4394124	HIGH MAST LIGHTING & FIRE ALARM BOX DETAILS
E-31	494125	4394125	TOP DECK CONDUIT SECTIONS
E-32	494126	4394126	BOTTOM DECK CONDUIT SECTIONS
E-33	494127	4394127	CONDUIT SUPPORT AND GROUNDING DETAILS
E-34	494128	4394128	FIRE ALARM, COMMUNICATION AND TELEPHONE DIAGRAMS
E-35	494129	4394129	CATHODIC PROTECTION SYSTEM DETAILS AND RISER DIAGRAMS
E-36	494130	4394130	CATHODIC PROTECTION SYSTEM DETAILS

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

DEPARTMENT OF THE NAVY

ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

NORFOLK, VIRGINIA

N62470-97-B-7041

NAVFAC
SPECIFICATION
NO. 05-97-7041

Appropriation: MCON

PIER 2 REPLACEMENT

AT

NAVAL STATION
NORFOLK, VIRGINIA

DESIGNED BY:

LANTNAVFACENGCOM
1510 Gilbert Street
Norfolk, Virginia 23511-2699

SPECIFICATION PREPARED BY:

Architectural: C.E. Tarkenton
Civil/Structural: M.C. Wilkins, P.E.
Fire Protection: J.H. Hogenson, P.E.
Mechanical: D.A. Vann, E.I.T.
Electrical: S.L. McMillion, P.E.
Date Submitted: January, 1999

SPECIFICATIONS APPROVED BY:

Specification Branch Head: E.J. Gallaher, P.E. G
Engineering and Design Director: W.H. Crone, P.E. WHC
For EFD for Commander, NAVFAC: Bill Crone
Date: 2/2/99

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SECTION 01110

SUMMARY OF WORK
12/96

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 General Intentions

It is the declared and acknowledged intention and meaning to provide and secure a new Pier 2 complete and ready for use.

1.1.2 Project Description

The work includes various forms of site demolition including but not limited to the removal of a jetty, an abandoned railroad ferry landing terminal and buildings which contain asbestos, lead and PCB lighting ballast. Also included is the construction of a new two level concrete Pier 2 and dredging of the surrounding area including all incidental related work.

1.1.3 Location

The work shall be located at the Norfolk Naval Station, Norfolk, Virginia, as indicated. The exact location will be shown by the Contracting Officer.

1.1.4 Metrification

The plans and specifications have been prepared using the soft (direct mathematical) conversion from U.S. customary units, inch-pound, to metric units and values. The products, materials and construction have been soft converted to metric. The intent is that products and materials commercially available be provided. In no case shall these documents require only specially produced metric items. The Contractor shall anticipate the costs and exercise extreme care in the interfacing of materials and trades.

1.2 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.3 LOCATION OF UNDERGROUND FACILITIES

Obtain digging permits prior to start of excavation. Scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.3.1 Notification Prior to Excavation

Notify the Contracting Officer at least 15 days prior to starting excavation work. Contact Miss Utility prior to excavating. Contractor is responsible for marking all utilities not marked by Miss Utility.

1.4 GOVERNMENT-FURNISHED MATERIAL AND EQUIPMENT

Pursuant to Contract Clause "FAR 52-245-4, Government-Furnished Property (Short Form)", the Government will furnish the following materials for installation by the Contractor:

DESCRIPTION	QUANTITY
Cleats	52
Bollards	22

1.4.1 Delivery Schedule

Notify the Contracting Officer in writing at least 7 calendar days in advance of the date on which the materials are required. Coordinate pick up or delivery of material with Contracting Officer.

1.4.2 Delivery Location

The materials are located within 1 km of the jobsite.

1.5 LIMITATION OF GOVERNMENT'S OBLIGATION

(a) Contract line ittems 0001 and 0002 are incrementally funded. For these items, the sum of $27,000,000.00 of the total price is presently available for payment and allocated to this contract. An allotment schedule is set forth in Paragraph (i) of this clause.

(b) For items identified in paragraph (a) of this clause, the Contractor agrees to perform up to the point at which the total amount payable by the Government, including reimbursement in the event of termination of these items for the Government's convenience, approximates the total amount currently allotted to the contract. The Contractor will not be oligated to continue work on those items beyond that point. The Government will not be obligated in any event to reimburse the Contractor in excess of the amount allotted to the contract those items regardless of anything to the contrary in the clause entitled "Termination for Convenience of the Government." As used in this clause, the total amount payable by the Government in the event of termination of applicable contract line items for convenience includes costs, profit and estimated termination settlement costs for those items.

(c) Notwithstanding the dates specified in the allotment schedule in paragraph (i) of this clause, the Contractor will notify the Contracting

Officer in writing at least ninety days prior to the date when, in the Contractor's best judgement, the work will reach the point at which the total amount payable by the Government, including any cost for termination for convenience, will approximate 85 percent of the total amount then allotted to the contract for performance of the applicable items. The notification will state (1) the estimated date when that point will be reached and (2) an estimate of additional funding, if any, needed to continue performance of the applicable line items up to the next scheduled date for allotment of funds identified in paragraph (i) of this clause, or to a mutually agreed upon substitute date. The notification will also advise the Contracting Officer of the estimated amount of additional funds that will be required for the timely performance of the items funded pursuant of this clause, for a subsequent period as may be specified in the allotment schedule in paragraph (i) of this clause or otherwise agreed to by the parties. If after such notification additional funds are not allotted by the date identified in the Contractor's notification, or by an agreed substitute date, the Contracting Officer will terminate any item(s) for which additional funds have not been alloted, pursuant to the clause of this contract entitled "Termination for Convenience of the Government."

(d) When additional funds are allotted for continued performance of the contract line item(s) identified in paragraph (a) of this clause, the parties will agree as to the period of contract performance which will be covered by the funds. The provisions of paragraphs(b) through (d) of this clause will apply in like manner to the additional allotted funds and agreed substitute date, and the contract will be modified accordingly.

(e) If, solely by reason of failure of the Government to allot additional funds, by the dates indicated below, in amounts sufficient for timely performance of the contract line item(s) identified in paragraph (a) of this clause, the Contractor incurs additional costs or is delayed in the performance of the work under this contract and if additional funds are allotted, an equitable adjustment will be made in the price or prices (including appropriate target, billing, and ceiling price where applicable) of the item(s), or in the time of delivery, or both. Failure to agree to any such equitable adjustment hereunder will be a dispute concerning a question of fact within the meaning of the clause entitled "Disputes."

(f) The Government may at any time prior to termination allot additional funds for the performance of the contract line item(s) identified in paragraph (a) of this clause.

(g) The termination provisions of this clause do not limit the rights of the Government under the clause entitled "Default." The provisions of this clause are limited to the work and allotment of funds for the contract line item(s) set forth in paragraph (a) of this clause. This clause no longer applies once the contract is fully funded except with regard to the rights of obligations of the parties concerning equitable adjustments negotiated under paragraphs (d) and (e) of this clause.

(h) Nothing in this clause affects the right of the Government to terminate this contract pursuant to the clause of this contract entitled "Termination for Convenience of the Government."

(i) The parties contemplate that the Government will allot funds to this contract in accordance with the following schedule:

On execution of the contract	$27,000,000.00

December 15, 1999	Remainder of contract

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01140

WORK RESTRICTIONS
03/97

PART 1 GENERAL

1.1 SPECIAL SCHEDULING REQUIREMENTS

a. The Government will have soundings done prior to the end of contract construction. Area "A" shall be at project depth at Pier 2 B.O.D. (Beneficial Occupancy Date).

b. Provide North West Switching Station, 10 meters of ductbank stubbed out of North wall of MH-D and associated work completed within 360 days of construction contract award. Cables 1 and 3 are not required to be installed within this time frame.

c. The existing Pier 2 will remain in operation during the entire construction period. The Contractor shall conduct his operations so as to cause the least possible interference with normal operations of the activity.

d. The work under this contract requires special attention to the scheduling and conduct of the work in connection with existing operations. Identify on the construction schedule each factor which constitutes a potential interruption to local operations.

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Station Regulations

Ensure that Contractor personnel employed on the Station become familiar with and obey Station regulations. Keep within the limits of the work and avenues of ingress and egress as directed. To minimize traffic congestion, delivery of materials shall be outside of peak traffic hours (6:30 to 8:00 a.m. and 3:30 to 5:00 p.m.) unless otherwise approved by the Contracting Officer. Do not enter restricted areas unless required to do so and until cleared for such entry. Permission to interrupt any station roads, railroads, or utility services shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption. The Contractor's equipment shall be conspicuously marked for identification.

1.2.2 Working Hours

Regular working hours shall consist of an 8 1/2 hour period between 7 a.m. and 3:30 p.m., Monday through Friday, and 7 a.m. to 11 p.m. on Saturday, excluding Government holidays.

1.2.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.2.4 Contractor's Use of Bldg. Z-86

The Contractor will be allowed to use the ground floor of Bldg. Z-86 for office and storage space until December of 1999. Exact limits of space will be as directed by the Contracting Officer. After December of 1999 the Contractor will have full use of the building.

1.2.5 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, oily waste water, telephone service, electric service, steam and fire alarm shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours." This time limit includes time for deactivation and reactivation.

d. Operation of Station Utilities: The Contractor shall not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer giving reasonable advance notice when such operation is required.

1.3 SECURITY REQUIREMENTS

Contract Clause "FAR 52.204-2, Security Requirements and Alternate II," and "FAC 5252.236-9301, Special Working Conditions and Entry to Work Area."

1.3.1 Naval Base, Norfolk, VA

a. Contractor registration. Register with the Base Police Truck Investigation Team, located at the Gate 5 Truck Control Station, Naval Air Station, Norfolk, VA 23511-5000, telephone number (757) 445-4807.

b. Storage and office trailer registration. Register storage and office trailers to be used on base with the truck investigation team. Trailers shall meet State law requirements and shall be in good condition.

(1) Trailers shall be lockable and shall be locked when not in use.

(2) Trailers shall have a sign in the lower left hand corner of left door of trailer with the following information: Company name, address, registration number of trailer or vehicle identification number, location on base, duration of contract or stay on base, contract number, local on-base phone number, off-base phone number of main office, and emergency recall person and phone number.

c. Equipment markings. Equipment owned or rented by the company shall have the company name painted or stenciled on the equipment in a conspicuous location. Rented equipment is to be conspicuously marked with a tag showing who rented the equipment. Register the equipment with the truck investigation team.

d. Procedure information. For additional information regarding registration procedures, contact the Officer in Charge of Contractors at (757) 445-1463 or LT Haughney at (757) 444-8856.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01200

PRICE AND PAYMENT PROCEDURES
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CORPS OF ENGINEERS (COE)

COE EP-1110-1-8	(1995) Construction Equipment Ownership and Operating Expense Schedule

1.2 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.2.1 SD-18, Records

a. Schedule of prices G

1.3 SCHEDULE OF PRICES

Within 15 calendar days of notice of award, prepare and deliver to Contracting Officer a schedule of prices (construction contract) on the forms furnished by the Government. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices therefor.

1.3.1 Construction Categories

The following construction categories apply to work covered by this specification:

CATEGORY	DESCRIPTION
151-20	Pier
165-10	Dredging
812-30	Electrical Distribution Lines
813-20	Substation more than 499 KVA
136-20	Parking and Service Area Lighting
880-10	Fire Alarm System
135-20	Telephone Lines
842-10	Potable Water Distribution Lines
832-10	Sanitary Sewer
851-10	Roads
852-10	Parking
852-30	Sidewalk
933-10	Demolition
871-10	Storm Sewer

Divide detailed breakdown into each construction category, stated in this contract. Subcontractors who may be involved in work under more than one of these categories shall be advised of this requirement in order to furnish such data without delay. Construction categories given above may be modified by Contracting Officer as necessary during course of work.

1.3.2 Schedule Instructions

Payments will not be made until the schedule of prices has been submitted to and approved by the Contracting Officer. Identify the cost for dredging operations, site work (both new and demolition) and construction of the new pier including incidental work.

1.4 CONTRACT MODIFICATION

In conjunction with the Contract Clause "DFARS 252.236-7000, Modification Proposals-Price Breakdown," and where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, equipment use rates shall be based upon the applicable provisions of the COE EP-1110-1-8.

1.5 CONTRACTOR'S INVOICE

1.5.1 Content of Invoice

Requests for payment in accordance with the terms of the contract shall consist of the following:

a. Contractor's Invoice on NAVFAC Form 7300/41, which shall show, in summary form, the basis for arriving at the amount of the invoice.

b. Contractor's Monthly Estimate for Voucher (LANTNAVFACENGCOM Form 4-4330/110 (New 7/84)), with subcontractor and supplier payment certification.

c. Affidavit to accompany invoice (LANTDIV NORVA Form 4-4235/4 (Rev. 5/81)).

d. Updated copy of submittal register.

e. Network mathematical analysis.

f. Include Contractor's Final Release Form.

1.5.2 Quantities of Monthly Invoices and Supporting Forms

Forms will be furnished by the Contracting Officer. Requests for payment shall be processed in accordance with "FAR 52.252-5, Payments Under Fixed-Price Construction Contracts." Monthly invoices and supporting forms for work performed through the anniversary award date of the contract shall be submitted to the Contracting Officer within 5 calendar days of the date of invoice (e.g., contract award date is the 7th of the month, the date of each monthly invoice shall be the 7th and the invoice shall be submitted by the 12th of the month) in the following quantities:

a. Contractor's invoice - Original and five copies

b. Contractor's monthly estimate for voucher - Original and two copies shall be required on jobs where there is a schedule of prices

c. Affidavit - Original

d. Updated submittal register - Two copies

e. Network mathematical analysis - Three copies

1.6 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor and will be subject to reduction for overpayments or increase for underpayments on preceding payments to the Contractor.

1.6.1 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this contract will, at the discretion of the Contracting Officer, be subject to the following:

a. Reasonable deductions due to defects in material or workmanship;

b. Claims which the Government may have against the Contractor under or in connection with this contract; and

c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor.

d. Record drawings not current as stated in Clause "FAC 5252.236-9310, Record Drawings."

1.6.2 Payment for Materials Offsite

Payments may be made to the Contractor for materials stored off construction sites under the following conditions:

a. Conditions described in the paragraph entitled "Payments to the Contractor";

b. Material within a distance of 40 km by streets and roads to the city of the construction site;

c. Materials adequately insured and protected from theft and exposure;

d. Materials not susceptible to deterioration or physical damage in storage or in transit to the job site are acceptable for progress payments. Items such as steel, machinery, pipe and fittings, and electrical cable are acceptable; items such as gypsum wallboard, glass, insulation, and wall coverings are not;

e. Materials in transit to the job site or storage site are not acceptable for payment.

1.6.3 Payment for Materials On Site

Payment may be made for materials delivered to the site but not yet incorporated into the construction. Materials on site shall be listed as a separate item on he Contract Performance Statement. The value of the materials shall be supported by the Schedule of Prices and a separate list of all materials being invoiced shall be submitted with the invoice in the following format:

MATERIAL ON SITE LAST ITEM PERIOD		MATERIAL RECEIVED THIS PERIOD		MATERIAL CONSUMED THIS PERIOD		MATERIAL ON SITE
	+		-		=	

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01310

ADMINISTRATIVE REQUIREMENTS
09/97

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.1.1 SD-18, Records

a. List of contact personnel G

1.2 MINIMUM INSURANCE REQUIREMENTS

Procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

a. Comprehensive general liability: $500,000 per occurrence

b. Automobile liability: $200,000 per person, $500,000 per occurrence, $20,000 per occurrence for property damage

c. Workmen's compensation as required by Federal and State workers' compensation and occupational disease laws.

d. Employer's liability coverage of $100,000, except in States where workers compensation may not be written by private carriers,

e. Others as required by State law.

1.3 CONTRACTOR PERSONNEL REQUIREMENTS

1.3.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.3.2 Identification Badges

Identification badges, if required, will be furnished without charge. Application for and use of badges will be as directed. Immediately report instances of lost or stolen badges to the Contracting Officer.

1.3.3 Contractor Personnel Requirements

Failure to obtain entry approval will not affect the contract price or time of completion.

1.4 PRECONSTRUCTION CONFERENCE

After award of the contract, but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation and submission of the schedule of prices, shop drawings and other submittals, scheduling, programming and prosecution of work. Major subcontractors who will be engaged in the work shall also attend.

1.5 PARTNERING

In order to most effectively accomplish the contract, the Government plans to form a cohesive Partnership with the contractor and its subcontractors. In addition, other key persons including the designer of record, principal individuals from the LANTNAVFACENGCOM and the customer who will occupy the facility will also be invited to participate in the Partnering process. The Partnering will strive to draw on the strengths of each organization in an effort to achieve a quality project done right the first time, within budget, on schedule, and with the contractor making a fair profit. This Partnering will be bilateral in make-up and participation is highly encouraged, but completely voluntary. The actual scope of the Partnership agreement is subject to bilateral agreement after award, but a preconstruction, off-site workshop of two days, and quarterly, or as needed one day follow-up sessions should be anticipated. Although subject to bilateral agreement before the initial workshop, it may prove beneficial to hold the Partnering meetings away from the normal commuting area to minimize interruptions during the daily sessions and allow the members of the Partnering to enhance working relationships through discussions and interaction. All participants should consider the cost of meals, lodging and transportation if an out of town site is selected. Participation by upper management is highly desirable and important. Costs associated with the Partnering effort including meeting room, audio visual accessories, costs of the facilitator, cost of refreshments and working meals will be shared equitably by the Government and the contractor. The cost of other meals, lodging, and transportation not directly associated with the formation and maintenance of the Partnership will be the responsibility of each of the Partnering participants.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01321

NETWORK ANALYSIS SCHEDULES
09/97

PART 1 GENERAL

1.1 DESCRIPTION

Prepare a progress chart pursuant to the clause entitled "FAR 52.236-15, Schedules for Construction Contracts" of the Contract Clauses that shall consist of a network analysis system. Include scheduling of construction, creation of the network, production of the reports, execution of the plan described by the network, participation in meetings with the Contracting Officer, and submission of progress and revision data, as hereinafter set forth. Utilize conventional NAS (Precedence Diagram) technique to satisfy both time and cost applications.

1.2 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.2.1 SD-18, Records

a. Network system analysis plan G

b. Monthly reports G

c. Approved Network G

d. Summary Network G

1.3 SOFTWARE

Provide network analysis software compatible with the contractor's scheduling software and data. The scheduling software package shall contain sire license and all user manuals normally provided by the software distributor. Submit hard copy and electronic copy of all network analysis and updates. Electronic copy shall be on 90 mm high density disks. The network analysis software shall be capable of running on a Government owned IBM compatable personal computer.

1.3.1 Software Training

Provide "Network Analysis Schedules" schedule software training for two government personnel if it is deemed necessary by the Contracting Officer. The training shall be conducted by a firm that normally provides training for the scheduling software and must be approved by the Contracting Officer. The training shall be an introductory/intermediate level class lasting a minimum of 24 hours per individual. Provide course material the training firm normally distributes at their software classes. Provide all necessary materials and equipment to conduct the training. Training shall be provided within 10 working days after notification to the Contractor, by the Contracting Officer. Unless agreed to by the Contracting Officer, the training site shall be at the Contracting Office.

1.4 NETWORK SYSTEM FORMAT

The system shall consist of time network scaled logic diagrams and accompanying mathematical analyses. Facilities with discrete completion dates shall be identified by separate subnetworks interconnected with the basic diagram.

1.4.1 Diagrams

Show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned. The basic concept of a network analysis diagram will be followed to show how the start of a given activity is dependent on the completion of preceding activities and how its completion restricts or restrains the start of following activities. The diagram shall clearly show the activities of the critical path. In addition to construction activities, detailed network activities shall include the submittal and approval of materials, samples, delivery of O&M manuals, training to be provided, shop drawings, the procurement of critical materials and equipment, receipt of materials with estimated procurement costs of major items for which payment of materials will be requested in advance of installation, fabrication of special material and equipment, and their installation and testing. Show activities of the Government that affect progress and contract-required dates for completion of all or parts of the work. Show activities indicating Government furnished materials and equipment utilizing delivery dates indicated in "FAR 52.245-2, Government Furnished Property (Fixed-Price Contract)." Show the following information on the diagrams for each activity:

a. Activity number

b. Description of the activity

c. Duration in work days

d. Responsibility code indicating the party responsible for accomplishment of the activity. As a minimum, provide a separate responsibility code for each subcontractor.

e. Area code indicating the area of the project in which the work will be performed.

1.4.2 Quantity and Numbering of Activities

Numbering shall be assigned so that, in general, predecessor activity numbers are smaller numerically than the successor activity numbers. Skip numbering shall be used on the network to allow insertion of additional activities for contract modifications and logic changes. The minimum number of activities in the final network diagram shall be 25. Dummies and interdependencies are not counted as activities.

1.4.3 Mathematical Analysis

The network diagram mathematical analysis shall include a tabulation of each activity shown on the detailed network diagrams. Provide the following information as a minimum for each activity:

a. Activity number

b. Activity description

c. Estimated duration of activities (by work days)

d. Earliest start date (by calendar date)

e. Earliest finish date (by calendar date)

f. Actual start date (by calendar date)

g. Actual finish date (by calendar date)

h. Latest start date (by calendar date)

i. Latest finish date (by calendar date)

j. Total float or slack

k. Monetary value of activity - values of activities will be broken down and listed by material/equipment costs, labor costs, and inspection testing costs. Value of inspection/testing will not be less than 10 percent of the activity value.

l. Responsibility code (including prime contractor, subcontractors, suppliers, Government, or other party responsible for accomplishment of an activity)

m. Manpower required (crew size)

n. Percentage of activity completed

o. Contractor's earnings based on portion of activity completed

The program or means used in making the mathematical computation shall be capable of compiling the total value of completed and partially completed activities. The program shall also be capable of accepting revised completion dates as modified by approved time extensions and recomputation of tabulation dates/costs and float accordingly.

1.4.4 Additional Requirements

In addition to the tabulation of activities, the computation will include the following data:

a. Identification of activities which are planned to be expedited by use of overtime or double shifts to be worked, including Saturdays, Sundays and holidays including dates of notification

b. On-site manpower loading schedule

c. A description of the major items of construction equipment planned for operations of the project. The description shall include the type, number of units, and unit capacities. Provide a schedule showing proposed time equipment will be on the job keyed to activities on which equipment will be used.

1.4.5 Required Sorts

List the activities in sorts or groups as follows:

a. By the preceding event number from lowest to highest and then in the order of the following activity number showing the current status of all activities.

b. By the amount of total float, from lowest to highest and then in order of activity number (Total Float or Slack Report) showing all incomplete activities

c. By latest allowable start dates, then in order of activity numbers.

d. Contractor's monthly payment request sorted by responsibility code with summary (cost earned by Responsibility Code Report)

e. Early Start Report

f. Listing of input data which generates the Input Data Report.

g. By the activity number from lowest to highest, showing preceding and succeeding activity numbers for each activity (Predecessor/Successor Report), and showing the current status of each activity.

1.5 SUBMISSION AND APPROVAL

1.5.1 Preliminary Meeting

If requested by the Contracting Officer, participate in a preliminary meeting to discuss the proposed schedule and requirements of this section prior to submission of the network.

1.5.2 Completed Network

Submit the complete network analysis, consisting of the network mathematical analysis and network diagrams, within 40 calendar days after contract award. Submit three copies of both the diagrams described in paragraph entitled "Diagrams" and required sorts listed in paragraph entitled "Required Sorts."

1.5.3 Review and Evaluation

The Contractor shall participate in a review and evaluation of the proposed network diagrams and analysis by the Contracting Officer. Revisions necessary as a result of this review shall be resubmitted for approval of the Contracting Officer within 10 calendar days after the conference. The approved schedule shall then be the schedule to be used by the Contractor for planning, organizing, and directing the work, reporting progress, and requesting payment for work accomplished.

1.5.4 Changes to the Network Analysis Schedule

If changes in the method of operating and scheduling are desired, the Contracting Officer shall be notified in writing stating the reasons for the change. If the Contracting Officer considers these changes to be of a major nature, the Contractor may be required to revise and submit for approval, without additional cost to the Government, network diagrams and required sorts. A change may be considered of a major nature if the estimated time required or actually used for an activity or the network logic is varied from the original plan to a degree that there is a reasonable doubt as to the effect on the contract completion dates. Changes which affect activities with adequate float time shall be considered a major change when their cumulative effect could extend the contract completion date.

1.5.5 Approved Network

Once the completed network has been approved by the Contracting Officer, the Contractor shall within 15 calendar days furnish:

a. Four copies of the network diagrams

b. Four copies of the required sorts listed in paragraph entitled "Required Sorts"

c. Four copies of the activity number specified in paragraph entitled "Monthly Reports"

d. Four copies of the Cash Flow Report indicating the cash flow based upon both the early and late start schedules.

For major revisions or changes to the network diagrams, once approved by the Contracting Officer, the Contractor shall submit these same diagrams and reports except submit the cash flow report only after the original complete network has been approved.

1.5.6 Monthly Reports

Submit at monthly intervals a report of the actual construction progress by updating the required sorts and the time scaled logic diagram. Initially, and monthly thereafter, produce a projected report of scheduled activities to be started, in process or completed during the upcoming reporting period, sorted by early start then activity number. At the end of the reporting period, Contractor and Government representatives shall jointly make entries on the preceding Look-Ahead Report to show actual progress. As a minimum, the following action will be accomplished:

a. Identify activities started and completed during the previous period

b. Show estimated duration (in work days) to complete each activity started but not completed during the previous period

c. Show estimated duration (in work days) to complete each activity started but not completed

d. Indicate percentage of cost payable for each activity

e. Reflect changes in the network diagram

Conformed modifications and pending proposed changes shall be shown on the update report. Submit a narrative report describing current and anticipated problem areas and/or delaying factors with their impact together with an explanation of corrective actions taken or proposed. Produce, from the marked-up Look-Ahead Report, updated required sorts for the project and use the accumulated cost for completed and partially completed activities as the basis for requesting progress payments, pursuant to, "FAR 52.232-5, Payments Under Fixed-Price Construction Contracts" and "FAR 52.236-5, Schedules for Construction Contracts." Contract status shall be evaluated on the basis of relative float on the critical path at the time of updating with negative relative float indicating the contract is behind schedule and positive relative float indicating status ahead of schedule. (Relative float is the current status of an activity in relation to the approved schedule completion date.) Submit three copies of the required sorts listed in paragraph entitled "Required Sorts" and the Look-Ahead Report with each payment request.

1.5.7 Submission Requirements

Provide network diagrams on size A0-1189 by 841 mm sheets. Updated diagrams shall show the date of the latest revision.

1.5.8 Summary Network

A summary network shall generally have the same network form as the final submitted NAS Schedule. The summary network will contain a minimal number of activities that represent the general approach of work sequence. It will be a time-scaled logical sequence of work phases, classifications and areas. It will not be necessary to cost load the summary network or show responsibility codes. The Contractor shall submit a summary network diagram immediately after approval of the complete network. A complete update shall be submitted every 6 months during the contract duration and immediately following approval of each major schedule change. Submit the following:

a. One mylar or equivalent of the summary network diagram

b. Three copies of the summary network diagram

c. Three copies of the summary I-J report

d. Three copies of the summary Total Float Report

e. Three copies of the Cash Flow Report indicating the cash flow for the current complete (not summary) network based upon both the early and late start schedules.

1.6 CONTRACT MODIFICATION

When a contract modification to the work is required, submit proposed revisions to the network reflecting the impact. Submit the proposed network revisions with the cost proposal for each proposed change. Should it be determined that a mathematical analysis utilizing the computer is necessary to analyze the impact, submit three copies of the Total Float Report and Input Data with the cost proposal. Incorporate contract modifications into the subsequent monthly update. Financial data shall not be incorporated until issuance of a contract modification on standard form 30 is signed by the Contracting Officer. Those contract modifications determined to have no impact will require only the identification of the affected activities as part of the proposed change proposal.

1.7 TIME EXTENSIONS

Float or slack is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date of any of the activities in the NAS Schedule. Float or slack is not time for the exclusive use or benefit of either the Government or the Contractor. Extension of time for performance required under the clauses titled "Changes," "Differing Site Conditions," "Default (Fixed-Price Construction)" or "Suspension of Work" of the Contract Clauses will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total float or slack along the network paths involved. Submit time extension requests with a narrative report supporting the request and three copies of the Total Float Report and input data if a mathematical analysis is necessary to support the narrative report.

1.8 MONTHLY COORDINATION MEETING

In conjunction with receipt of the Monthly Report, a coordination meeting will be held each month on site to discuss the report. The Contractor shall make a presentation of the previously submitted Monthly Report to the Contracting Officer so as to provide an overview of the project's schedule and provide an opportunity to discuss items of coordination.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES
09/97

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal

Shop drawings, product data, samples, and administrative submittals presented for review and approval. Contract Clauses "FAR 52.236-5, Material and Workmanship," paragraph (b) and "FAR 52.236-21, Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

1.1.2 Types of Submittals

All submittals are classified as indicated in the paragraph "Schedule of Submittal Descriptions." The submittals also are grouped as follows:

a. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this Contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate a portion of the work.

b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this Contract.

c. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.

d. Administrative submittals: Data presented for reviews and approval to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the Contract documents.

1.1.3 Approving Authority

The person authorized to approve a submittal.

1.1.4 Work

As used in this section, on- and off-site construction required by the Contract documents, including labor necessary to produce the construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Submit the following in accordance with the requirements of this section.

1.2.1 SD-18, Records

a. Submittal register G

1.2.1.1 Submittal Register
State for each submittal the Contractor's planned submittal date. Submit with the Quality Control Plan within 45 calendar days after contract award.Insert dates on copies of the "Submittal Register." Obtain the original from the following source:

a. From the register with the submittal items filled in, attached.

1.2.1.2 Submittal Register Preparation

Prepare and maintain a submittal register. Instructions are included in paragraph titled "SUBMITTAL REGISTER INSTRUCTIONS" for use in developing the submittal register. The submittal register with columns (c) through (f) completed, is designated the initial submittal register required as a part of the quality control plan. The remaining columns on the submittal register forms shall be completed by the Contractor. Additional details concerning the use of the submittal register will be explained at the preconstruction conference.

1.3 PROCEDURES FOR SUBMITTALS

1.3.1 Reviewing, Certifying, Approving Authority

The QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. The approving authority on submittals is the QC Manager unless otherwise specified for the specific submittal. At each "Submittal" paragraph in the individual specification sections, a notation "G," following a submittal item, indicates the Contracting Officer is the approving authority for that submittal item.

1.3.2 Constraints

a. Submittals listed or specified in this Contract shall conform to the provisions of this section, unless explicitly stated otherwise.

b. Submittals shall be complete for each definable feature of work; components of the definable feature interrelated as a system shall be submitted at the same time.

c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.

d. Approval of a separate material, product, or component does not imply approval of assembly in which the item functions.

1.3.3 Scheduling

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of the work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

b. Except as specified otherwise, allow a review period, beginning with receipt by the approving authority, that includes at least 15 working days for submittals for QC Manager approval and 20 working days for submittals for Contracting Officer approval. The period of review for submittals with Contracting Officer approval begins when the Government receives the submittal from the QC organization. The period of review for each resubmittal is the same as for the initial submittal.

c. For submittals requiring review by the Fire Protection Engineer, allow a review period, beginning when the Government receives the submittal from the QC organization, of 30 working days for return of the submittal to the Contractor. The period of review for each resubmittal is the same as for the initial submittal.

1.3.4 Variations

Variations from contract requirements require Government approval pursuant to Contract Clause entitled "FAR 52.236-21, Specifications and Drawings for Construction" and will be considered where advantageous to the Government. When proposing a variation, submit a written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Government. If lower cost is a benefit, also include an estimate of the cost saving. Identify the proposed variation separately and include the documentation for the proposed variation along with the required submittal for the item. When submitting a variation for approval, the Contractor warrants the following:

1.3.4.1 Variation Is Compatible

The Contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of the work.

1.3.4.2 Review Schedule Is Modified

In addition to the normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.3.5 Contractor's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.

b. Transmit submittals to the QC organization in orderly sequence, in accordance with the Submittal Register, and to prevent delays in the work, delays to the Government, or delays to separate contractors.

c. Advise the Contracting Officer of variation, as required by the paragraph entitled "Variations."

d. Correct and resubmit submittal as directed by the approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the Contractor shall provide a copy of that previously submitted transmittal including all reviewer comments for use by the approving authority. Direct specific attention, in writing or on resubmitted submittal, to revisions not requested by the approving authority on previous submissions.

e. Furnish additional copies of submittals when requested by the Contracting Officer, to a limit of 20 copies per submittals.

f. Complete work which must be accomplished as a basis of a submittal in time to allow the submittal to occur as scheduled.

g. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted", except to the extent that a portion of the work must be accomplished as a basis of the submittal.

1.3.6 QC Organization Responsibilities

a. Note the date on which the submittal was received from the contractor on each submittal.

b. Review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.

c. Review submittals for conformance with project design concepts and compliance with the Contract documents.

d. Act on submittals, determining the appropriate action based on the QC organization's review of the submittal.

(1) When the QC Manager is the approving authority, take the appropriate action on the submittal from the possible actions defined in the paragraph entitled, "Actions Possible."

(2) When the Contracting Officer is the approving authority or when a variation has been proposed, forward the submittal to the Government with the certifying statement or return the submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of the submittal determines the appropriate action.

e. Ensure that material is clearly legible.

f. Stamp each sheet of each submittal with the QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When the approving authority is the Contracting Officer, the QC organization will certify submittals forwarded to the Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number N62470-97-C-7041, is in compliance with the Contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____________________, Date _______

(Signature when applicable)

Certified by QC Manager _____________________________, Date ______"
(Signature)

(2) When the approving authority is the QC Manager, the QC manager will use the following approval statement when returning submittals to the Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with Contract Number N62470-97-C-7041, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is _____ approved for use.

Certified by Submittal Reviewer ______________________, Date ______
(Signature when applicable)

Approved by QC Manager _______________________________, Date _____"
(Signature)

g. Sign the certifying statement or approval statement. The person signing the certifying statements shall be the QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

h. Update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by the Contracting Officer.

i. Retain a copy of approved submittals at the project site, including the Contractor's copy of approved samples.

1.3.7 Government's Responsibilities

When the approving authority is the Contracting Officer, the Government will:

a. Note the date on which the submittal was received from the QC Manager, on each submittal for which the Contracting Officer is the approving authority.

b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with the Contract documents.

c. Identify returned submittals with one of the actions defined in the paragraph entitled "Actions Possible" and with markings appropriate for the action indicated.

1.3.8 Actions Possible

Submittals will be returned with one of the following notations:

a. Submittals marked "not reviewed" will indicate the submittal has been previously reviewed and approved, is not required as a submittal, does not have evidence of being reviewed and approved by the Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Returned submittals deemed to lack review by the Contractor or to be incomplete shall be resubmitted with appropriate action, coordination, or change.

b. Submittals marked "approved" "approved as submitted" authorize the Contractor to proceed with the work covered.

c. Submittals marked "approved as noted" authorize the Contractor to proceed with the work as noted provided the Contractor takes no exception to the notations.

d. Submittals marked "revise and resubmit" or "disapproved" indicate the submittal is incomplete or does not comply with the design concept or the requirements of the Contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until the resubmittal is approved.

1.4 FORMAT OF SUBMITTALS

1.4.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to the office of the approving authority. Transmit submittals with a transmittal form prescribed by the Contracting Officer and standard for the project. The transmittal form shall identify the Contractor, indicate the date of the submittal, and include information prescribed by the transmittal form and required in the paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.4.2 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on the transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction Contract number.

c. The section number of the specification section by which the submittal is required.

d. The submittal description (SD) number of each component of the submittal.

e. When a resubmission, an alphabetic suffix on the submittal description, for example, SD-10A, to indicate the resubmission.

f. The name, address, and telephone number of the subcontractor, supplier, manufacturer and any other second tier contractor associated with the submittal.

g. Product identification and location in project.

1.4.3 Format for Product Data

a. Present product data submittals for each section as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate the specification section number and paragraph number to which it pertains.

c. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for the project.

1.4.4 Format for Shop Drawings

a. Shop drawings shall not be less than (297 x 210 mm) nor more than (1189 x 841 mm).

b. Present (297 x 210 mm) sized shop drawings as a part of the bound volume for the submittals required by the section. Present larger drawings in sets.

c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to the information required in the paragraph entitled "Identifying Submittals."

d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Identify materials and products for work shown.

1.4.5 Format of Samples

a. Furnish samples in the sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less Than 50 by 75 mm: Built up to (297 x 210 mm).

(3) Sample of Materials Exceeding (297 x 210 mm): Cut down to (297 x 210 mm) and adequate to indicate color, texture, and material variations.

(4) Sample of Linear Devices or Materials: 250 mm length or length to be supplied, if less than 250 mm. Examples of linear devices or materials are conduit and handrails.

(5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

(6) Sample Panel: 1200 by 1200 mm.

(7) Sample Installation: 10 square meters.

b. Samples Showing Range of Variation: Where variations are unavoidable due to the nature of the materials, submit sets of samples of not less than three units showing the extremes and middle of the range.

c. Reusable Samples: Incorporate returned samples into the work only if so specified or indicated. Incorporated samples shall be in undamaged condition at the time of use.

d. Recording of Sample Installation: Note and preserve the notation of the area constituting the sample installation but remove the notation at the final clean up of the project.

e. When a color, texture or pattern is specified in naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.4.6 Format of Administrative Submittals

a. When the submittal includes a document which is to be used in the project or become a part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document, but to a separate sheet accompanying the document.

b. Operation and Maintenance Manual Data: Submit in accordance with Section 01781, "Operation and Maintenance Data." Include components required in that section and the various technical sections.

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of Product Data

a. Submit five copies of submittals of product data requiring review and approval only by the QC organization and eight copies of product data requiring review and approval by the Contracting Officer. Submit three copies of submittals of product data for operation and maintenance manuals.

1.5.2 Number of Copies of Shop Drawings

Submit shop drawings in compliance with the quantity requirements specified for product data.

1.5.3 Number of Samples

a. Submit one sample, or one set of samples showing range of variation, of each required item.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.5.4 Number of Copies of Administrative Submittals

a. Unless otherwise specified, submit the administrative submittals compliance with the quantity requirements specified for product data.

b. Submit administrative submittals required under "SD-19, Operation and Maintenance Manuals" to conform to Section 01781, "Operation and Maintenance Data."

1.6 FORWARDING SUBMITTALS

1.6.1 Samples Required of the Contractor

Submit samples to the Commander, LANTNAVFACENGCOM, 1510 Gilbert Street, Norfolk, Virginia 23511-2699.

1.6.2 Shop Drawings, Product Data, and O&M Data

As soon as practicable after award of the contract, and before procurement or fabrication, submit, except as specified otherwise, to the Commander, LANTNAVFACENGCON, Code 04A1, 1510 Gilbert Street, Norfolk, Virginia 23511-2699, the shop drawings, product data and O&M Data required in the technical sections of this specification. One copy of the transmittal form for submittals shall be forwarded to the Resident Officer in Charge of Construction.

Submittals for asbestos removal and disposal and the Environmental Protection Plan shall be submitted to the Resident Officer in Charge of Construction for review and approval thereby.

1.7 SCHEDULE OF SUBMITTAL DESCRIPTIONS (SD)

SD-01, Data

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-02, Manufacturer's Catalog Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. A type of product data.

SD-03, Manufacturer's Standard Color Charts

Preprinted illustrations displaying choices of color and finish for a material or product. A type of product data.

SD-04, Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work. A type of shop drawing.

SD-05, Design Data

Design calculations, mix designs, analyses, or other data, written in nature and pertaining to a part of the work. A type of shop drawing.

SD-06, Instructions

Preprinted material describing installation of a product, system, or material, including special notices and Material Safety Data Sheets, if any, concerning impedances, hazards, and safety precautions. A type of product data.

SD-07, Schedules

A tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work. A type of shop drawing.

SD-08, Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other lower tier contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality. A type of shop drawing.

SD-09, Reports

Reports of inspection and laboratory test, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-10, Test Reports

A report signed by an authorized official of an independent testing laboratory that a material, product, or system identical to the material, product or system to be provided has been tested in accordance with requirements specified by naming the test method and material. The test report must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. Testing must have been within three years of the date of award of this Contract. A type of product data.

SD-11, Factory Test Reports

A written report which includes the findings of a test required to be performed by the manufacturer on a prototype or on an actual portion of the work prepared for this project, before it is shipped to the job site. The report must be signed by an authorized official of the manufacturer's test facility or testing laboratory and must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-12, Field Test Reports

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. The report must be signed by an authorized official of a testing laboratory or agency and must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-13, Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system, or material meet specified requirements. The statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address. A type of shop drawing.

SD-14, Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work. A type of sample.

SD-15, Color Selection Samples

Samples of the available choice of colors, textures, and finishes of a product or material, presented over substrates identical in texture to that proposed for the work. A type of sample.

SD-16, Sample Panels

An assembly constructed at the project site in a location acceptable to the Contracting Officer and using materials and methods to be employed in the work; completely finished; maintained during construction; and removed at the conclusion of the work or when authorized by the Contracting Officer. A type of sample.

SD-17, Sample Installations

A portion of an assembly or material constructed where directed and, if approved, retained as a part of the work. A type of sample.

SD-18, Records

Documentation to ensure compliance with an administrative requirement or to establish an administrative mechanism. A type of administrative submittal.

SD-19, Operation and Maintenance Manuals

Data intended to be incorporated in an Operation and Maintenance Manual. A type of administrative submittal.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SUBMITTAL REGISTER INSTRUCTIONS

Use submittal register form for the project's Submittal Register and to track progress of submittals as they are processed.

a. The Government will supply submittal register forms, with columns (c) through (f) completed to the extent that will be required by the Government.

   Column (c): Lists each specification section in which a submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-04, Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate submittal reviews. Do not consider entries in column (e) as limiting project requirements.

Column (f): Indicates approving authority for each submittal. A "G" indicates approval by Contracting Officer; a blank indicates approval by QC Manager.

b. Column (g) through (r) will be used by Contractor, Approving Authority organization and the Government on their own copies to record data established by the Contractor.

c. Action Codes (j) and (o): NR - Not Received; AN - Approved as noted; A - Approved; RR - Disapproved, Revised, and Resubmit (others may be prescribed by the Transmittal Form).

CONTRACTOR

Column (g) through (i): Contractor dates.

Column (j): Action code; and (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l): List date submittal.

Column (q): List date approval received.

APPROVING AUTHORITY

Column (l): List date submittal received.

Column (m) through (p).

Column (q): List date returned to Contractor.

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
PIER 2 REPLACEMENT

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01200	SD-18 Records														
			Schedule of prices	1.3	G												
		01310	SD-18 Records														
			List of contact personnel	1.4.1	G												
		01321	SD-18 Records														
			Network system	1.4	G												
			Monthly reports	1.5.6	G												
			Approved Network	1.5.5	G												
			Summary Network	1.5.8	G												
		01330	SD-18 Records														
			Submittal register	1.2.1.1	G												
		01450	SD-18 Records														
			(QC) plan	1.6	G												
		01500	SD-02 Manufacturer's Catalog Data														
			Backflow preventers	1.2.3.1													
			SD-04 Drawings														
			Traffic control plan	1.5.1.1	G												
			SD-13 Certificates														
			Backflow preventers	1.2.3.1													
			SD-12 Field Test Reports														
			Test results	3.3													
		01525	SD-08 Statements														
			Accident prevention plan (APP)	1.4.1.1	G												
			Activity Hazard Analysis (AHA)	1.4.1.2	G												
			SD-18 Records														
			Daily Confined Space Entry Permit	3.3.8													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION: PIER 2 REPLACEMENT

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01525	Reports	1.15													
		01561	SD-02 Manufacturer's Catalog Data														
			Sediment Fence	2.1													
			Dust Suppressors	2.4													
			Erosion Control Matting	2.6													
			Filter Cloth Underliner	2.3.1.2													
			SD-04 Drawings														
			Erosion Control Plan	1.4	G												
			SD-08 Statements														
			Construction Sequence Schedule	1.3.3.1	G												
		01575	SD-08 Statements														
			Environmental protection plan	1.7	G												
			SD-12 Field Test Reports														
			Laboratory analysis	1.3.2.1													
			SD-18 Records														
			Preconstruction survey	1.3.3.1													
			Solid waste disposal permit	1.3.3.2													
			Waste determination	1.3.3.3													
			documentation														
			Waste determination	3.4.1													
			documentation														
			Disposal documentation for	1.3.3.4													
			hazardous and regulated waste														
			Contractor 40 CFR employee	1.3.3.5													
			training records														
			Regulatory notification	1.3.3.6													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION: PIER 2 REPLACEMENT

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION: ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY: DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01575	Solid waste disposal report	1.3.3.7													
		01770	SD-18 Records														
			As-built drawings	1.2.1	G												
			Record of materials	1.2.2	G												
			Equipment/product warranty tag	1.3.2	G												
			SD-19 Operation and Maintenance														
			Manuals														
			Equipment/product warranty list	1.3.1													
		02220	SD-08 Statements														
			Demolition plan	1.4.1.1													
			SD-18 Records														
			Receipts	1.4.2.1													
		02272	SD-02 Manufacturer's Catalog Data														
			Fabric Literature	1.2.1.1	G												
			SD-04 Drawings														
			Engineered penetrations	3.3	G												
			SD-06 Instructions														
			Manufacturing, Sampling, and	2.2.1													
			Testing														
			SD-13 Certificates														
			Geotextile	2.1.1	G												
			SD-14 Samples														
			Geotextile	2.1.1	G												
		02315	SD-09 Reports														
			Borrow Site Testing	1.3													
			SD-12 Field Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION: PIER 2 REPLACEMENT

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION / GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES — SUBMIT	CONTRACTOR: SCHEDULE DATES — APPROVAL NEEDED BY	CONTRACTOR: SCHEDULE DATES — MATERIAL NEEDED BY	CONTRACTOR ACTION — ACTION CODE	CONTRACTOR ACTION — DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY — DATE FWD TO OTHER REVIEWER	APPROVING AUTHORITY — DATE RCD FROM OTH REVIEWER	APPROVING AUTHORITY — ACTION CODE	APPROVING AUTHORITY — DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02315	Fill and backfill	3.10.2.1													
			Select material	3.10.2.2													
			Density tests	3.10.2.3													
		02325	SD-04 Drawings														
			Submerged pipeline	3.2.6.4													
			Soundings or sweepings	3.3.2	G												
		02362	SD-02 Manufacturer's Catalog Data														
			Piles	2.1	G												
			Driving equipment	3.2.1	G												
			SD-04 Drawings														
			Piles	2.1	G												
			SD-10 Test Reports														
			Pile Performance	2.2	G												
		02365	SD-02 Manufacturer's Catalog Data														
			Cleats and Bollards	2.1	G												
			Grout	2.2													
			Bolts, Nuts and Washers	2.3	G												
			Asphalt varnish	2.4													
			Sleeves	2.5													
			Aluminum epoxy mastic	2.6	G												
			SD-04 Drawings														
			Cleats and Bollards	2.1	G												
			SD-13 Certificates														
			Cleats and Bollards	2.1													
			Grout	2.2													
			Bolts, Nuts and Washers	2.3													

SUBMITTAL REGISTER

CONTRACT NO.

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		02365	Asphalt varnish	2.4													
			Sleeves	2.5													
		02396	SD-02 Manufacturer's Catalog Data														
			Resilient, foam filled marine	1.2.3	G												
			fenders														
			SD-05 Design Data														
			Resilient, foam filled marine	1.2.3													
			fenders														
			SD-10 Test Reports														
			Fender compression test	2.4.1													
			Fender cyclic-compression test	2.4.2													
			Fender sustained-load test	2.4.3													
			Fender pull-through test	2.4.4													
			Elastomeric skin thickness test	2.4.5													
		02397	SD-02 Manufacturer's Catalog Data														
			Fender	2.1	G												
			Hardware	2.3													
			SD-05 Design Data														
			curve	2.4.1													
			Dimension	2.1													
			Fender	2.1													
			Design	2.1													
			SD-06 Instructions														
			Installation	3.1													
			SD-11 Factory Test Reports														
			Minimum Tensile Strength	2.2													

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		02397	Shore Hardness (Durometer)	2.2													
			Modulus at 400 Percent Elongation	2.2													
			Maximum Compression Set	2.2													
			Tear Resistance	2.2													
			Minimum Elongation	2.2													
			Ozone Resistance	2.2													
			Low Temperature Impact	2.2													
			Resistance														
			Water Absorption	2.2													
			Heat Resistance	2.2													
			Compression Deflection Resistance	2.2													
			Fender Compression Test	2.4.1													
		02455	SD-04 Drawings														
			Drawings	1.5.1.1	G												
			SD-05 Design Data														
			design calculations	1.5.2.1	G												
			mix design	1.5.2.2	G												
			SD-08 Statements														
			Quality control procedures	1.5.3.1	G												
			SD-10 Test Reports														
			Pozzolan	2.2.1.1	G												
			SD-11 Factory Test Reports														
			test reports	1.5.5.1	G												
			SD-18 Records														
			batch ticket information	1.5.6.1	G												
			Sheet pile installation	1.5.6.2	G												

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		02456	SD-04 Drawings															
			Piles	1.2.1.1	G													
			Driving helmets, capblocks, and	1.2.1.2	G													
			pile cushions															
			SD-05 Design Data															
			Concrete mix design	1.2.7	G													
			SD-08 Statements															
			quality control procedures	1.2.3.1														
			Installation procedures	1.2.3.2	G													
			equipment	2.3														
			Geotechnical consultant	1.2.3.3	G													
			documentation															
			SD-11 Factory Test Reports															
			Aggregates	1.2.4.1	G													
			SD-12 Field Test Reports															
			Concrete	2.2														
			Test piles	3.2.1	G													
			Load tests	3.2.3	G													
			SD-13 Certificates															
			Prestressing steel	2.1.7	G													
			cement	2.1.1	G													
			Concrete mix design	1.2.7														
		02457	SD-04 Drawings															
			Steel sheet piles	2.1	G													
			SD-08 Statements															
			Pile pulling method	3.3.2														

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		02457	Pile driving equipment	1.2.2.1														
			SD-18 Records															
			Pile driving record	3.4	G													
		02465	SD-04 Drawings															
			Piles	1.2.1.1	G													
			Driving helmets, capblocks, and	1.2.1.2	G													
			pile cushions															
			Pile driving plan	1.2.5.2	G													
			Batter pile support plan	1.2.5.2	G													
			SD-05 Design Data															
			Concrete mix design	2.2	G													
			Grout	2.1.10														
			Joint Sealing Material	2.1.11														
			SD-06 Instructions															
			Dynamic Pile Testing	3.1.1	G													
			Interior Inspection for Pile Damage	3.1.4	G													
			SD-07 Schedules															
			Order List	2.7														
			SD-08 Statements															
			quality control procedures	1.2.5.1														
			equipment	2.6	G													
			SD-11 Factory Test Reports															
			Aggregates	1.2.6.1														
			SD-12 Field Test Reports															
			Concrete Strength	2.3.7	G													
			Test piles	3.2.1	G													

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		02465	Load tests	3.2.2	G												
			SD-13 Certificates														
			Prestressing Tendons	2.1.7													
			cement	2.1.1													
			Concrete mix design	2.2													
			SD-18 Records														
			Pile records	3.2.3	G												
		02510	SD-02 Manufacturer's Catalog Data														
			Backflow Preventer														
			Water Meter	2.1.2.8													
		02530	SD-02 Manufacturer's Catalog Data														
			Pipeline materials	2.1													
			SD-04 Drawings														
			Precast concrete manhole	2.4.1.1													
			Metal items	2.4.2													
		02553	SD-01 Data														
			Pipe-stress and system expansion	1.6.1.1	G												
			calculations														
			Cathodic protection system	1.6.1.2	G												
			calculations														
			Manufacturer's data sheets	1.6.1.3	G												
			SD-02 Manufacturer's Catalog Data														
			Pipe														
			Fittings														
			Insulation														
			Cathodic Protection														

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		02553	Coatings															
			Conduit															
			Field Closures															
			Anchors															
			SD-04 Drawings															
			Heat distribution system	1.6.3.1	G													
			Heat distribution system	1.6.8.1	G													
			SD-08 Statements															
			Work plan	1.6.4.1	G													
			Quality assurance	1.6.4.2														
			Thermal performance testing	1.6.4.3	G													
			SD-09 Reports															
			WSL system test	1.6.5.1	G													
			SD-13 Certificates															
			UHDS manufacturer	1.6.6.1	G													
			UHDS design	1.6.6.2	G													
			Certificate of compliance		G													
			Testing firm qualification	1.6.6.4	G													
			Welds	1.6.6.5	G													
			SD-18 Records															
			Daily written report	1.6.7.1														
			SD-19 Operation and Maintenance															
			Manuals															
			Heat distribution system	1.6.3.1														
			Heat distribution system	1.6.8.1														
		02554	SD-02 Manufacturer's Catalog Data															

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		02554	Piping	2.1														
			Valves	2.3														
			Strainers	2.4.2														
			Pipe hangers and supports	2.4.1														
			Traps	2.4.3														
			Gages	2.4.4														
			Steam flow meters	2.4.7														
			SD-08 Statements															
			Certification of welder's	1.3.2.1														
			qualifications															
			SD-19 Operation and Maintenance															
			Manuals															
			Manhole drainers															
			Steam flow meters	2.4.7														
		02588	SD-05 Design Data															
			mix design	1.2.1.1														
			SD-08 Statements															
			Quality control procedures	1.2.2.1														
		02630	SD-02 Manufacturer's Catalog Data															
			Cast-iron soil piping	2.1.1														
			Composite plastic piping	2.1.2														
			Polyvinyl chloride (PVC) plastic	2.1.3														
			piping															
			Corrugated high density	2.1.4														
			polyethylene piping															
		02741	SD-05 Design Data															

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		02741	Job-mix formula	1.2.1.1													
			SD-13 Certificates														
			Stone base course	2.1.2													
			Paint	2.1.4													
		02752	SD-02 Manufacturer's Catalog Data														
			Curing materials	2.1.7													
			Admixtures	2.1.4													
			SD-05 Design Data														
			mix design	2.2													
			SD-10 Test Reports														
			Fly ash	2.1.4.5													
			Pozzolan	2.1.4.5													
			Concrete mix	1.2.3.1													
			SD-12 Field Test Reports														
			Compressive strength tests	3.6.2.3													
			SD-13 Certificates														
			Paint	2.1.9													
		02762	SD-04 Drawings														
			Preformed Compression seals	2.1.3.3													
			SD-06 Instructions														
			Joint sealants	2.1.3													
			Preformed compression seals	2.1.3.3													
			SD-08 Statements														
			Equipment list	1.6													
			SD-11 Factory Test Reports														
			Joint sealer	3.4.2													

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		02762	SD-18 Records														
			Joint sealer	3.4.2													
			Joint filler	2.1.1													
		02821	SD-02 Manufacturer's Catalog Data														
			Chain-link fencing	2.1													
			Accessories	2.1.4													
		03300	SD-02 Manufacturer's Catalog Data														
			Materials for curing concrete	2.4.7													
			Joint sealants	2.4.10													
			Joint filler	2.4.9													
			SD-04 Drawings														
			Reinforcing steel	1.3.2.1	G												
			SD-05 Design Data														
			mix design	2.3.1	G												
			SD-08 Statements														
			Curing concrete elements	1.3.4.1													
			Pumping concrete	1.3.4.2													
			SD-10 Test Reports														
			Concrete mix design	1.3.5.1	G												
			SD-12 Field Test Reports														
			Compressive strength tests	3.9.2.3	G												
		03410	SD-02 Manufacturer's Catalog Data														
			inserts	2.2.7.1													
			Bearing pads	2.2.8													
			SD-04 Drawings														
			Drawings of precast members	1.3.2.1	G												

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		03410	SD-05 Design Data															
			design calculations	1.3.3.1	G													
			Concrete mix design	1.3.3.2	G													
			SD-08 Statements															
			Fabrication	2.3														
			SD-11 Factory Test Reports															
			Contractor-furnished mix design	2.1	G													
			SD-18 Records															
			batch ticket	1.3.6.1														
		03412	SD-04 Drawings															
			Drawings	1.3.1.1	G													
			SD-05 Design Data															
			design calculations	1.3.2.1	G													
			mix design	1.3.2.2	G													
			SD-08 Statements															
			Quality control procedures	1.3.3.1														
			SD-11 Factory Test Reports															
			test reports	1.3.4.1														
			SD-18 Records															
			batch ticket information	1.3.5.1														
		05120	SD-02 Manufacturer's Catalog Data															
			Load indicator washers	2.2.1.4														
			SD-04 Drawings															
			Fabrication drawings	1.4.2.1	G													
			SD-08 Statements															
			Erection plan	1.4.3.1														

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		05120	Welding procedures and	1.4.3.2													
			qualifications														
			SD-10 Test Reports														
			Bolts, nuts, and washers	2.2													
			SD-13 Certificates														
			Nonshrink grout	2.3.2													
			Galvanizing	2.4													
			AISC Quality Certification	1.5													
		05500	SD-02 Manufacturer's Catalog Data														
			Ladders	2.5													
			Chains	2.3													
			Floor Plates, Patterned	2.6													
			SD-04 Drawings														
			Expansion joint covers		G												
			Ladders	2.5	G												
			angles and plates	2.8	G												
		06611	SD-02 Manufacturer's Catalog Data														
			Structural FRP Shapes	2.1	G												
			Trench Covers	2.3	G												
			Lift Station Cover Plates	2.3	G												
			SD-04 Drawings														
			Stairs	2.2	G												
			Trench Covers	2.3	G												
			Lift Station Cover Plates	2.3	G												
			SD-06 Instructions														
			Epoxy Resin	2.4	G												

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		06650	SD-02 Manufacturer's Catalog Data															
			Solid polymer fabrications	2.1	G													
		07920	SD-02 Manufacturer's Catalog Data															
			Sealants	2.1														
			Primers	2.2														
			Bond breakers	2.3														
			Backstops	2.4														
		08110	SD-02 Manufacturer's Catalog Data															
			Frames	2.1	G													
		08312	SD-04 Drawings															
			Sliding Metal Doors	2.1	G													
		08800	SD-06 Instructions															
			Setting and sealing materials	2.3														
			Glass setting	3.2														
		11312	SD-02 Manufacturer's Catalog Data															
			Pipe and fittings	2.1	G													
			Check valves	2.2.2	G													
			Gate valves	2.2.1	G													
			Submersible sewage grinder	2.3	G													
			pumps															
			Pump motor	2.4	G													
			Flexible flanged coupling	2.1.4	G													
			Pump Station Control System	2.5	G													
			SD-04 Drawings															
			Pump Station Control System	2.5	G													

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		11312	SD-19 Operation and Maintenance														
			Manuals														
			Submersible Sewage Grinder	2.3	G												
			Pumps														
		13111	SD-02 Manufacturer's Catalog Data														
			Rectifiers	2.3	G												
			Cable	2.4.2	G												
			Insulating flange sets	2.6	G												
			Dielectric unions	2.7	G												
			Anodes	2.1	G												
			Test stations	2.5	G												
			Anode junction boxes	2.5	G												
			Anode vent pipe	2.2	G												
			Reference electrodes	2.11	G												
			Shunt resistors	2.5.4	G												
			Variable resistors	2.5.5	G												
			Anode backfill	2.1.4	G												
			Bonding boxes	3.1.6	G												
			Surge arrestors	2.8	G												
			SD-04 Drawings														
			Rectifiers	2.3	G												
			Insulating flange sets	2.6	G												
			Anode installation	3.1	G												
			Test stations	2.5	G												
			Bonding boxes	3.1.6	G												
			Anode junction boxes	2.5	G												

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		13111	Anode vent pipe	2.2	G												
			Joint bonds	3.1.9	G												
			SD-08 Statements														
			Qualifications of Corrosion	1.4	G												
			Engineer														
			SD-12 Field Test Reports														
			Initial Cathodic Protection System	3.2.1.4	G												
			Field Test Report														
			One Year Warranty Period	3.2.1.6	G												
			Cathodic Protection System Field														
			Test Report														
			Final Cathodic Protection System	3.2.1.7	G												
			Field Test Report														
			SD-19 Operation and Maintenance														
			Manuals														
			Cathodic protection system	3.2													
			Rectifier replacement/spare parts	2.3.13													
			list														
		13114	SD-02 Manufacturer's Catalog Data														
			Galvanic Anodes	2.1	G												
			Impressed Current Anodes	2.2	G												
			Rectifiers	2.3	G												
			Cable	2.4.2	G												
			Insulating flange sets	2.6	G												
			Dielectric unions	2.7	G												
			Test stations	2.5	G												

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		13114	Anode junction boxes	2.5	G												
			Casing insulators and seals	2.11	G												
			Reference electrodes	2.12	G												
			Shunt resistors	2.5.5	G												
			Rectifier shunt resistors	2.3.11	G												
			Anode backfill	2.2.4	G												
			Bonding boxes	3.1.7	G												
			SD-04 Drawings														
			Cathodic Protection Design	1.5	G												
			Rectifiers	2.3	G												
			Test stations	2.5	G												
			Bonding boxes	3.1.7	G												
			Anode junction boxes	2.5	G												
			Insulating flange sets	2.6	G												
			Joint bonds	3.1.10	G												
			SD-05 Design Data														
			Cathodic protection design	1.5	G												
			SD-08 Statements														
			Qualifications of Corrosion	1.4	G												
			Engineer														
			SD-12 Field Test Reports														
			Initial Cathodic Protection System	3.2.1.3	G												
			Field Test Report														
			One Year Warranty Period	3.2.1.5	G												
			Cathodic Protection System Field														
			Test Report														

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		13114	Final Cathodic Protection System	3.2.1.6	G												
			Field Test Report														
			SD-19 Operation and Maintenance														
			Manuals														
			Cathodic protection system	3.2													
			Rectifier replacement/spare parts	2.3.13													
			list														
		13281	SD-02 Manufacturer's Catalog Data														
			Local exhaust equipment	3.1.4	G												
			Vacuums	3.1.5	G												
			Respirators	3.1.1.1	G												
			Pressure differential automatic	3.1.4	G												
			recording instrument														
			Amended water	1.2.2	G												
			Glovebags	3.1.7	G												
			Material Safety Data Sheets	1.3.8	G												
			(MSDS) for all materials														
			Encapsulants	2.1	G												
			SD-08 Statements														
			Asbestos hazard abatement plan	1.4.2.1	G												
			Testing laboratory	1.4.2.2	G												
			Private qualified person	1.4.2.3	G												
			documentation														
			Landfill approval	1.4.2.4	G												
			Employee training	1.4.2.5	G												
			Medical certification	1.4.2.6	G												

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		13281	Waste shipment records	1.4.2.4	G												
			Respiratory Protection Program	1.4.2.7	G												
			Hazardous waste manifest	1.4.2.4	G												
			SD-12 Field Test Reports														
			Air sampling results	1.4.3.1	G												
			Pressure differential recordings for	1.4.3.2	G												
			local exhaust system														
			Asbestos disposal quantity report	3.3.3.2	G												
			Clearance sampling	3.2.6.3	G												
			SD-18 Records														
			Notifications	1.4.4.1	G												
			Rental equipment	1.4.4.2	G												
			Respirator program records	1.4.4.3	G												
			Permits and licenses	1.3.4	G												
		13282	SD-02 Manufacturer's Catalog Data														
			Vacuum filters	1.5.4	G												
			Respirators	1.5.1	G												
			SD-06 Instructions														
			Chemicals	2.1	G												
			Material safety data sheets	2.1	G												
			SD-08 Statements														
			Qualifications of CP	1.3.3.1	G												
			Testing laboratory	1.3.3.2	G												
			Third party consultant	1.3.3.4	G												
			Material Containing Lead Removal	1.3.3.3	G												
			Plan														

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		13282	Rental equipment notification	1.5.3	G												
			Respiratory protection program	1.4.4	G												
			Hazard communication program	1.4.5	G												
			disposal facility	3.2.5	G												
			Hazardous waste management	1.4.6	G												
			plan														
			Assessment data report	1.3.4.2	G												
			SD-12 Field Test Reports														
			Sampling results	1.3.4.1	G												
			Assessment Data Report	1.3.4.2	G												
			SD-13 Certificates														
			Vacuum filters	1.5.4	G												
			SD-18 Records														
			manifest	3.2.5	G												
			medical examinations	1.4.1	G												
			training certification	1.4.3.1	G												
		13286	SD-08 Statements														
			Qualifications of CIH	1.5.1.1	G												
			Training Certification	1.5.1.1	G												
			PCB and Mercury-Containing Lamp	1.5.1.2	G												
			Removal Work Plan														
			PCB and Mercury-Containing Lamp	1.5.1.3	G												
			Disposal Plan														
			SD-18 Records														
			Transporter certification	3.5.2	G												
			Certification of Decontamination	3.2.4	G												

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		13286	Certificate of Disposal and/or	3.5.2.1	G													
			Recycling															
		13851	SD-02 Manufacturer's Catalog Data															
			Testing instruments	1.9.1	G													
			Fire alarm boxes	2.1	G													
			Pedestal	2.1.2	G													
			Wires and cables	2.2	G													
			SD-04 Drawings															
			Exterior fire alarm reporting	1.4	G													
			SD-08 Statements															
			Parts reliability	1.5.3.1	G													
			Installer qualifications	1.5.3.2	G													
			Test procedures	1.5.3.3	G													
			Installation certificate	1.5.3.4	G													
			Installation personnel	1.5.3.5	G													
			Current UL listings or FM approvals	1.5.3.6	G													
			SD-12 Field Test Reports															
			Ground resistance tests	3.8.1.1	G													
			Dielectric strength and insulation	3.8.1.2	G													
			resistance tests															
			Box and transmitter tests	3.8.1.3	G													
			Final performance and acceptance	3.8.2	G													
			tests															
			SD-18 Records															
			Record wiring diagrams	1.5.5.1	G													

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		13851	SD-19 Operation and Maintenance														
			Manuals														
			Fire alarm boxes	2.1	G												
		15081	SD-02 Manufacturer's Catalog Data														
			Insulation	2.1													
			Jacket	2.3													
			SD-06 Instructions														
			field-applied insulation	1.2													
		15192	SD-02 Manufacturer's Catalog Data														
			Pipe and fittings	2.1.1													
			Valves	2.1.3													
			Pumps	2.2.1	G												
			Expansion Joints	2.1.4.10	G												
			Dielectric unions	2.1.4.1													
			SD-08 Statements														
			Welding procedure	1.4.2.1													
			Qualification of welders	1.4.2.2													
			List of welder's names and	1.4.2.3													
			symbols														
			SD-13 Certificates														
			Dielectric unions	2.1.4.1													
			Coating materials	2.1.6													
			Coating application procedure	2.1.6													
			Expansion Joints	2.1.4.10													
			SD-19 Operation and Maintenance														
			Manuals														

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		15192	Pumps	2.2.1														
		15194	SD-02 Manufacturer's Catalog Data															
			Pipe	2.1.1														
			Valves	2.5														
			Expansion joints	2.6.4														
			Strainers	2.6.2														
			Protective coatings	2.7														
			Fittings	2.2														
			SD-04 Drawings															
			Aviation fuel distribution	1.3.2.1														
			SD-06 Instructions															
			Expansion joints	2.6.4														
			Protective coatings	2.7														
		15700	SD-02 Manufacturer's Catalog Data															
			Packaged terminal heat pumps	2.1.1														
			Electric baseboard units	2.2														
			SD-06 Instructions															
			Installation manual	1.3.2.1														
			SD-19 Operation and Maintenance															
			Manuals															
			Packaged terminal heat pumps	2.1.1														
			Electric baseboard units	2.2														
		16081	SD-08 Statements															
			Qualifications	1.3.1.1	G													
			Acceptance test and inspections	1.3.1.2	G													
			procedure															

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		16081	SD-12 Field Test Reports															
			Acceptance tests and inspections	3.1		G												
		16272	SD-01 Data															
			Transformer losses	1.4.1.1		G												
			SD-02 Manufacturer's Catalog Data															
			Pad-mounted transformers	2.3		G												
			SD-04 Drawings															
			Pad-mounted transformer drawings	1.4.3.1		G												
			SD-08 Statements															
			Year 2000 (Y2K) Compliance	1.4.4.1		G												
			Warranty															
			SD-11 Factory Test Reports															
			design tests	2.5.2		G												
			routine and other tests	2.5.3		G												
			SD-12 Field Test Reports															
			acceptance checks and tests	3.6.1		G												
			Ground resistance test reports	1.4.6.1		G												
			SD-18 Records															
			Transformer test schedule	2.5.1		G												
			SD-19 Operation and Maintenance															
			Manuals															
			Transformer(s)	1.4.8.1		G												
		16301	SD-02 Manufacturer's Catalog Data															
			Cables	2.3		G												
			SD-12 Field Test Reports															
			acceptance checks and tests	3.1.1		G												

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		16301	Ground resistance test reports	1.3.2.1	G												
		16303	SD-02 Manufacturer's Catalog Data														
			Fiberglass conduit	2.1.1.4	G												
			Fiberglass conduit fittings	2.1.2.4	G												
			Fiberglass conduit supports	2.1.3	G												
			Fiberglass cable wells	2.1.17	G												
			2000 volt conductors	2.1.5.2	G												
			Single-pole in-line power	2.1.7	G												
			connectors														
			Lightning masts	2.1.21	G												
			Medium voltage cable	2.1.8	G												
			Medium voltage cable terminations	2.1.9	G												
			Medium voltage cable joints	2.1.10	G												
			Live end caps	2.1.11	G												
			frames and covers	2.1.16.1	G												
			Cable racks	2.1.18	G												
			Sealing material	2.1.16	G												
			Precast concrete manholes	2.1.16	G												
			SD-04 Drawings														
			Precast concrete manhole	1.4.2.1	G												
			drawings														
			Cable Well Drawings	1.4.2.2	G												
			SD-08 Statements														
			Cable splicer/terminator	1.4.3.1	G												
			Qualifications of fiberglass conduit	1.4.3.2	G												
			manufacturer														

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		16303	Fiberglass conduit manufacturer's	1.4.3.3	G												
			warranty														
			SD-09 Reports														
			Arc-proofing test	2.2.1	G												
			Medium voltage cable qualification	2.2.2	G												
			and production tests														
			SD-12 Field Test Reports														
			Field Acceptance Checks and	3.2.1	G												
			Tests														
			SD-13 Certificates														
			2000 volt conductor ampacity	1.4.6.1	G												
		16341	SD-02 Manufacturer's Catalog Data														
			SF6 Insulated Interrupter Switch	2.2	G												
			Vault-type	2.2	G												
			SD-04 Drawings														
			Load Interrupter Switch Drawings	1.4.2.1	G												
			SD-08 Statements														
			Year 2000 (Y2K) Compliance	1.4.3.1	G												
			Warranty														
			SD-11 Factory Test Reports														
			switch design and production tests	2.3.1	G												
			SD-12 Field Test Reports														
			Acceptance Checks and Tests	3.4.1	G												
			Ground resistance tests	1.4.5.1	G												
			SD-19 Operation and Maintenance														
			Manuals														

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		16341	SF6 insulated interrupter switch	2.2	G													
		16343	SD-02 Manufacturer's Catalog Data															
			High-voltage vacuum circuit breakers	2.2	G													
			High-voltage air interrupter switches	2.3	G													
			High-voltage air disconnect switches	2.4	G													
			Medium voltage cable terminations	2.5	G													
			Surge arresters	2.6	G													
			34.5 kV outdoor bus	2.7	G													
			Power fuses and fuse disconnecting switches	2.8	G													
			Potential transformers	2.9	G													
			Station service transformer	2.9	G													
			Protective relays	2.11.1	G													
			Lockout relays	2.11.2	G													
			Control switches	2.11.3	G													
			Indicating lights	2.11.4	G													
			SD-04 Drawings															
			High-voltage vacuum circuit breakers	2.2	G													
			High-voltage air interrupter switches	2.3	G													
			High-voltage air disconnect switches	2.4	G													

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CONTRACTOR

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		16343	Power fuses and fuse	2.8	G													
			disconnecting switches															
			Controlboard drawings	1.4.2.1	G													
			SD-08 Statements															
			Year 2000 (Y2K) Compliance	1.4.3.1	G													
			Warranty															
			SD-10 Test Reports															
			High-voltage vacuum circuit	1.4.4.1	G													
			breaker design tests															
			High-voltage vacuum circuit	1.4.4.2	G													
			breaker production tests															
			SD-12 Field Test Reports															
			Acceptance checks and tests	3.4.1	G													
			SD-19 Operation and Maintenance															
			Manuals															
			High-voltage vacuum circuit	2.2	G													
			breakers															
			High-voltage air interrupter	2.3	G													
			switches															
			High-voltage air disconnect	2.4	G													
			switches															
			Power fuses and fuse	2.8	G													
			disconnecting switches															
			Protective relays	2.11.1	G													
		16360	SD-01 Data															
			Transformer Losses	1.4.1.1	G													

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		16360	Assembled Operation and	2.5	G												
			Maintenance Manuals														
			SD-02 Manufacturer's Catalog Data														
			Separable Insulated High-Voltage	2.2.1.1	G												
			Connectors														
			Surge Arresters	2.2.1.2	G												
			Grounding Elbows	2.2.1.3	G												
			Connector Protective Caps	2.2.1.4	G												
			Transformer Accessories	2.2.2.4	G												
			Switchgear	2.2.4	G												
			Power Receptacles	2.2.5	G												
			Current Transformers	2.2.9	G												
			Panelboards	2.2.6	G												
			Station Battery	2.2.7	G												
			Station Battery Charger	2.2.8	G												
			Push Buttons	2.2.10	G												
			Control Receptacles	2.2.11	G												
			SD-04 Drawings														
			Transformer Drawings	1.4.3.1	G												
			Switchgear and Power Outlet	1.4.3.2	G												
			Assembly														
			Skid Base Fabrication Drawings	1.4.3.3	G												
			SD-08 Statements														
			Year 2000 (Y2K) Compliance	1.4.4.1	G												
			Warranty														
			SD-11 Factory Test Reports														

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		16360	Transformer design tests	2.6.2	G												
			Transformer acceptance tests	2.6.3	G												
			Transformer routine and other tests	2.6.4	G												
			Switchgear design and production	2.6.5	G												
			tests														
			SD-13 Certificates														
			Coating system	1.4.6.1	G												
			SD-18 Records														
			Equipment test schedule	2.6.1	G												
			SD-19 Operation and Maintenance														
			Manuals														
			Separable Insulated High-Voltage	2.2.1.1	G												
			Connectors														
			Surge Arresters	2.2.1.2	G												
			Grounding Elbows	2.2.1.3	G												
			Transformer	2.2.2	G												
			Switchgear	2.2.4	G												
		16403	SD-02 Manufacturer's Catalog Data														
			Receptacles	2.12													
			Circuit breakers	2.13.3	G												
			Switches	2.11	G												
			Transformers	2.16	G												
			Motor controllers	2.18	G												
			Metering	2.24	G												
			Cable Trays	2.5	G												
			Single-Pole Power Receptacles	2.26.3	G												

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		16403	Three-Pole Power Receptacles	2.26.2	G												
			SD-04 Drawings														
			Panelboards	2.13	G												
			Transformers	2.16	G												
			Cable Tap Cabinets	2.20	G												
			Remote Trip Pushbutton Panel	2.27	G												
			Power Stations	2.26	G												
			SD-08 Statements														
			Fuses	2.15	G												
			Year 2000 (Y2K) Compliance	1.4.3.2	G												
			Warranty														
			SD-11 Factory Test Reports														
			Transformer tests	1.4.4.1	G												
			SD-12 Field Test Reports														
			600-volt wiring test	3.2.2	G												
			Grounding system test	3.2.5	G												
			Transformer tests	1.4.4.1	G												
			SD-19 Operation and Maintenance														
			Manuals														
			Metering	2.24	G												
		16511	SD-01 Data														
			Training	3.4	G												
			SD-02 Manufacturer's Catalog Data														
			Fluorescent lighting fixtures	2.3	G												
			Fluorescent electronic ballasts	1.4.2.1	G												

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		16511	Fluorescent electromagnetic	2.3.2		G												
			ballasts															
			Fluorescent lamps	2.3.3		G												
			High-intensity-discharge (HID)	2.4		G												
			lighting fixtures															
			HID ballasts	2.4.1		G												
			High-pressure sodium (HPS) lamps	2.4.2		G												
			Lighting contactor	2.6		G												
			Photocell switch	2.7		G												
			Emergency lighting equipment	2.8		G												
			Concrete poles	2.9.1		G												
			Brackets	2.10														
			Steel Poles	2.9.2		G												
			High-mast Lowering Device	2.11		G												
			Obstruction light	2.5		G												
			SD-04 Drawings															
			Luminaire drawings	1.4.3.1		G												
			Poles	1.4.3.2		G												
			SD-08 Statements															
			Year 2000 (Y2K) Compliance	1.4.4.1		G												
			Warranty															
			SD-10 Test Reports															
			Test Data for luminaires	1.4.5.1		G												
			SD-12 Field Test Reports															
			Operating test	3.5														
			SD-18 Records															

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		16511	Information card	1.4.7.1	G													
		16712	SD-02 Manufacturer's Catalog Data															
			FO Cable	2.1	G													
			SD-11 Factory Test Reports															
			FO cable reel test	2.3.1	G													
			SD-12 Field Test Reports															
			Field test	3.2.1	G													
		16721	SD-02 Manufacturer's Catalog Data															
			Wire and cable	2.9	G													
			Cable splices, and connectors	2.6	G													
			Closures	2.4	G													
			Telephone receptacles	2.5.1	G													
			T1 Receptacles	2.5.2	G													
			Building protector assemblies	2.3.1	G													
			Connector blocks	2.3.2	G													
			Protector modules	2.3.1.1	G													
			Main distribution frame	2.3	G													
			SD-04 Drawings															
			Communication panels	2.5	G													
			SD-06 Instructions															
			Installation procedures	1.4.3.1	G													
			SD-08 Statements															
			Cable splicer's qualifications	1.4.4.1	G													
			Installer qualifications	1.4.4.2	G													
			Test plan	1.4.4.3	G													

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		16721	Year 2000 (Y2K) Compliance	1.4.4.4	G												
			Warranty														
			SD-12 Field Test Reports														
			Pre-installation tests	3.2.1	G												
			Acceptance tests	3.2.2	G												

SECTION 01450

QUALITY CONTROL
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 880	(1995) Criteria for Use in Evaluation of Testing Laboratories and Organization for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C 1077	(1996) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3666	(1996) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 3740	(1995) Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(1995; Rev. C) Agencies Engaged in the Testing and/or Inspection of Materials Used on Construction
ASTM E 543	(1995; Rev. A) Evaluating Agencies that Perform Nondestructive Testing

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1996) Safety and Health Requirements Manual

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-18 Records

a. Quality Control (QC) plan G

Submit a QC plan within 30 calendar days after receipt of Notice of Award.

a. The QC Plan shall include a preliminary submittal of the list of definable features of work and the Quality Control Checklist that shall cover the first 90 days of construction.

b. Any approval by the Government of the QC Plan shall be considered to be "approved as noted, resubmittal required" and will be in effect only until the completed list of definable features of work is received and approved. If the completed list of definable features of work and completed network schedule is not received within the time indicated in the paragraph entitled "Completed Network" of Section 01321, "Network Analysis Schedules," the QC Plan will become disapproved and all work, except for the work authorized in the paragraph entitled "Preliminary Work Authorized Prior to Approval," will stop.

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Deliver the following to the Contracting Officer:

a. Combined Contractor Production Report/Contractor Quality Control Report (1 sheet): Original and 1 copy, by 10:00 AM the next working day after each day that work is performed;

b. QC specialist Reports: Originals and 1 copy by 10:00 AM the next working day after each day that work is performed, attached to the Contractor Quality Control Report;

c. Field Test Reports: 2 copies, within 2 working days after the test is performed, attached to the Contractor Quality Control Report;

d. Monthly Summary Report of Tests: 2 copies attached to the Contractor Quality Control Report;

e. Testing Plan and Log, 2 copies, at the end of each month;

f. Rework Items List: 2 copies, by the last working day of the month

g. QC Meeting Minutes: 2 copies, within 2 working days after the meeting and;

h. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, a QC Plan, a QC Plan meeting, a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

1.4.1 Preliminary Work Authorized Prior to Approval

The only work that is authorized to proceed prior to the approval of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.2 Approval

Approval of the QC Plan is required prior to the start of construction. The Contracting Officer reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel shall be subject to acceptance by the Contracting Officer.

1.4.3 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to acceptance by the Contracting Officer.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this contract. The QC Manager shall not be designated as the safety competent person as defined by COE EM-385-1-1. The QC Manager is required to attend the QC Plan meeting, attend the Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control except for those phases of control designated to be performed by QC specialists, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC specialists, Testing Laboratory personnel and any other inspection and testing personnel required by this Contract.

1.5.1.2 Qualifications

A graduate of a four year accredited college program in one of the following disciplines: Engineering, Architecture, Construction Management, Engineering Technology or Building Construction with a minimum of 10 years experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this Contract (major waterfront construction). The individual must be familiar with the requirements of COE EM-385-1-1, and have experience in the areas of hazard identification and safety compliance.

1.5.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager shall have completed the course entitled "Construction Quality Management for Contractors." This course is periodically offered by the Virginia AGC. The class is facilitated by the Norfolk District of the Corps of Engineers. The point of contact with AGC is Steve Vermillion at 804-346-3383. The point of contact at LANTDIV is Jim Baldwin at 757-322-8421.

1.5.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC manager.

1.5.3 Assistant QC Manager Duties and Qualifications

Provide an assistant to the QC Manager at the work site to perform the three phases of control, perform submittal review, ensure testing is performed, and prepare QC certifications and documentation required by this Contract. The Assistant QC Manager shall be on the work site during supplemental work shifts beyond the regular shift and shall perform the duties of the QC Manager during such supplemental shift work. The qualification requirements for the Assistant QC Manager shall be 10 years experience. The individual must be familiar with the requirements of COE EM-385-1-1, and have experience in the areas of hazard identification and safety compliance.

1.5.4 QC Specialists Duties and Qualifications

Provide a separate QC specialist at the work site for each of the areas of responsibilities, specified below, who shall assist and report to the QC Manager and who shall have no duties other than their assigned quality control duties. QC specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings, and be physically present at the construction site to perform the three phases of control and prepare documentation for each definable feature of work in their area of responsibility at the frequency specified below.

Qualification/Experience in Area of Responsibility	Area of Responsibility	Frequency
Structural Engineer- 10 years of experience in cast-in-place and precast concrete	Installation of cast-in-place and precast concrete. Sections: 03300,03410,03412	two days per week 8 hours per day during installation cast-in-place and precast concrete
Electrical Specialist- 15 years experience in similar work	Review installation and checkout of switchgear, transformers	full time during installation or checkout

1.5.5 Safety Specialist

Provide a Safety Specialist at the work site to perform safety management, surveillance, inspections and safety enforcement for the contractor. The

Safety Specialist shall be the safety "competent person" as defined by COE EM-385-1-1. The Safety Specialist shall be at the work site at all times whenever work or testing is being performed, shall conduct daily safety inspections and shall have no other duties other than safety management, inspections, and safety enforcement on this contract.

1.5.6 QC Assistant

Provide an Administrative Assistant at the work site until the work has been accepted. The primary duty shall be to assist the QC Manager in processing and maintaining files for submittals, preparing and publishing reports and meeting minutes. After primary duties are accomplished, other duties may be assigned provided the duties do not interfere with primary duties.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Requirements

Provide, for approval by the Contracting Officer, a QC plan submitted in a 3-ring binder with pages numbered sequentially that covers both on-site and off-site work and includes the following:

a. A table of contents listing the major sections identified with tabs in the following order:

I. QC ORGANIZATION
II. NAMES AND QUALIFICATIONS
III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL
IV. OUTSIDE ORGANIZATIONS
V. APPOINTMENT LETTERS
VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER
VII. TESTING LABORATORY INFORMATION
VIII. TESTING PLAN AND LOG
IX. PROCEDURES TO COMPLETE REWORK ITEMS
X. DOCUMENTATION PROCEDURES
XI. LIST OF DEFINABLE FEATURES
XII. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL USING A QUALITY CONTROL CHECKLIST
XIII. PROCEDURES FOR COMPLETION INSPECTION

b. A chart showing the QC organizational structure.

c. Names and qualifications, in resume format, for each person in the QC organization.

d. Duties, responsibilities and authorities of each person in the QC organization.

e. A listing of outside organizations such as, architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

f. Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of quality control, and their authority to stop work which is not in compliance with the contract. The QC Manager shall issue letters of direction to the Assistant QC Manager and all other QC specialists outlining their duties, authorities, and responsibilities. Copies of the letters shall be included in the QC plan.

g. Procedures for reviewing, approving and managing submittals. Provide the names of the persons in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in section entitled "Submittal Procedures."

h. Testing laboratory information required by the paragraphs entitled "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

i. A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

j. Procedures to identify, record, track and complete rework items.

k. Documentation procedures, including proposed report formats.

l. List of definable features of work. A definable feature of work (DFOW) is a task which is separate and distinct from other tasks and requires separate quality control requirements. A DFOW could be identified by different trades or disciplines or by an item or activity on the construction schedule. Although each specification section could be considered a definable feature of work there frequently is more than one definable feature of work under a particular section. The list shall be cross-referenced to the contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule. For projects requiring a Network Analysis System, the list of definable features of work shall include but not be limited to all critical path activities.

   Include all activities for which this specification requires QC specialists or Specialty Inspection Personnel.

m. A Quality Control Checklist. For each DFOW, develop a list of quality control activities broken down by preparatory, initial and follow-up phases. Each list shall include a breakdown of quality checks that will be used when performing the quality control functions, inspections, and tests required by the contract documents. The Quality Control Checklist should be developed with a view towards obtaining quality construction by planning ahead and identifying potential problems for each definable feature of work.

n. Procedures for Identifying and Documenting the Completion Inspection process. Include in these procedures the responsible party for punch out inspection, prefinal inspection, and final acceptance inspection.

1.7 QC PLAN MEETING

Prior to submission of the QC plan, meet with the Contracting Officer to discuss the QC plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC plan requirements prior to plan development and submission.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to the start of construction, meet with the Contracting Officer to present the QC program required by this Contract. The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, and the coordination of the Contractor's management, production and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each definable feature of work. As a minimum, the Contractor's personnel required to attend shall include an officer of the firm, the project manager, project superintendent, QC Manager, Alternate QC Manager, Assistant QC Manager, QC specialists, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the Contracting Officer. A copy of the signed minutes shall be provided to all attendees by the Contractor. Repeat the coordination and mutual understanding meeting when a new QC Manager is appointed.

Provide a room acceptable to the Contracting Officer for the one day meeting. The room shall be equipped with VCR and monitor equipment, overhead projector and a flipchart. Submit for Contracting Officer approval the location, date and agenda for this meeting.

1.9 QC MEETINGS

After the start of construction, the QC Manager shall conduct QC meetings once every two weeks at the work site with the project superintendent and QC specialists. The QC Manager shall prepare the minutes of the meeting and provide a copy to the Contracting Officer within 2 working days after the meeting. The Contracting Officer may attend these meetings. The QC Manager shall notify the Contracting Officer at least 48 hours in advance of each meeting. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;

b. Review the schedule and the status of work:

   (1) Work or testing accomplished since last meeting

   (2) Rework items identified since last meeting

   (3) Rework items completed since last meeting;

c. Review the status of submittals:

   (1) Submittals reviewed and approved since last meeting

   (2) Submittals required in the near future;

d. Review the work to be accomplished in the next 2 weeks and documentation required:

(1) Establish completion dates for rework items

(2) Update the schedule showing planned and actual dates of the preparatory, initial and follow-up phases, including testing and any other inspection required by this contract

(3) Discuss construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each definable feature of work

(4) Discuss status of off-site work or testing

(5) Documentation required;

(6) Discuss upcoming Activity Hazard Analyses:

e. Resolve QC and production problems:

(1) Assist in resolving Request for Information issues; and

f. Address items that may require revising the QC plan:

(1) Changes in QC organization personnel

(2) Changes in procedures.

g. Review health and safety plan

1.10 THREE PHASES OF CONTROL

The Three Phases of Control shall adequately cover both on-site and off-site work and shall include the following for each definable feature of work.

1.10.1 Preparatory Phase

Notify the Contracting Officer at least 2 work days in advance of each preparatory phase. This phase shall include a meeting conducted by the QC Manager and attended by the QC specialists, the superintendent, and the foreman responsible for the definable feature. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Quality Control Checklist. Perform the following prior to beginning work on each definable feature of work:

a. Review each paragraph of the applicable specification sections;

b. Review the Contract drawings;

c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;

e. Examine the work area to ensure that the required preliminary work has been completed;

f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

g. Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each definable feature of work; and

h. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.

1.10.2 Initial Phase

Notify the Contracting Officer at least 2 work days in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, conduct the initial phase with the QC Specialists, the superintendent, and the foreman responsible for that definable feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily Contractor Quality Control Report and in the Quality Control Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work:

a. Establish the quality of workmanship required;

b. Resolve conflicts;

c. Ensure that testing is performed by the approved laboratory, and

d. Check work procedures for compliance with the Safety Plan and the appropriate activity hazard analysis to ensure that applicable safety requirements are met.

1.10.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary until the completion of each definable feature of work and document in the daily Contractor Quality Control Report and in the Quality Control Checklist:

a. Ensure the work is in compliance with Contract requirements;

b. Maintain the quality of workmanship required;

c. Ensure that testing is performed by the approved laboratory;

d. Ensure that rework items are being corrected; and

e. Perform safety inspections.

1.10.4 Additional Preparatory and Initial Phases

Additional Preparatory and Initial Phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a definable feature is resumed after substantial period of inactivity, or if other problems develop.

1.10.5 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.

1.11 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in section entitled "Submittal Procedures."

1.12 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.12.1 Testing Laboratory Requirements

Provide an independent testing laboratory qualified to perform sampling and tests required by this Contract. When the proposed testing laboratory is not accredited by an acceptable "Qualified National Authority" listed in the paragraph entitled "Qualified National Authority," submit to the Contracting Officer for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the following requirements:

Provide an accredited independent testing laboratory or an independent testing laboratory who has evidence that is has begun the accreditation process and has requested an inspection of its laboratory facilities by a "Qualified National Authority." The laboratory's scope of accreditation must include the following ASTM standards as appropriate to the testing field.

a. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E 329.

b. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C 1077. However, if Laboratory Evaluation has not been performed, so state and request a deviation submitting evidence of the laboratories quality control program, individual technicians resumes and tests that they perform, laboratory history, and certifying that the remainder of ASTM C 1077 requirements have been met and request an inspection by the Contracting Officer.

c. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D 3666. However, if technicians do not have NICET certification, submit resumes of all laboratory personnel engaged in testing demonstrating their experience and request a deviation.

d. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D 3740. However, if competence has not been established by inspection, so state and request a deviation submitting evidence of the laboratories quality control program, individual technicians resumes and test that they perform, laboratory history, and certifying that the remainder of ASTM D 3740 requirements have been met and request an inspection by the Contracting Officer.

e. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A 880.

f. Laboratories engaged in nondestructive testing (NDT) shall meet the requirements of ASTM E 543.

g. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

1.12.2 Qualified National Authorities

Qualified National Authorities are the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology, the American Association of State Highway and Transportation Officials (AASHTO) program, and the American Association for Laboratory Accreditation (A2LA) program and the Washington Association of Building Officials (WABO) (Approval authority for WABO is limited to projects within Washington State). Furnish to the Contracting Officer, a copy of the Certificate of Accreditation and Scope of Accreditation. The scope of the laboratory's accreditation shall include the test methods required by the Contract.

1.12.3 Inspection of Testing Laboratories

Prior to approval of non-accredited laboratories, the proposed testing laboratory facilities and records may be subject to inspection by the Contracting Officer. Records subject to inspection include equipment inventory, equipment calibration dates and procedures, library of test procedures, audit and inspection reports by agencies conducting laboratory evaluations and certifications, testing and management personnel qualifications, test report forms, and the internal QC procedures.

1.12.4 Capability Check

The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.12.5 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify Contracting Officer immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.12.6 Test Reports and Monthly Summary Report of Tests

The QC Manager shall furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Contracting Officer. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.13 QC CERTIFICATIONS

1.13.1 Contractor Quality Control Report Certification

Each Contractor Quality Control Report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.13.2 Invoice Certification

Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

1.13.3 Completion Certification

Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract."

1.14 COMPLETION INSPECTIONS

1.14.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the FAR clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Include in the punch list any remaining items on the "Rework Items List" which were not corrected prior to the Punch-Out Inspection. The punch list shall include the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the Contracting Officer. The QC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the Government that the facility is ready for the Government "Pre-Final Inspection."

1.14.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" may be developed as a result of this inspection. The QC Manager shall ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in timely manner and shall be accomplished within the time slated for completion of the entire work, or any particular increment thereof if the project is divided into increments by separate completion dates.

1.14.3 Final Acceptance Inspection

The QC Manager, the QC specialists, the superintendent or other primary contractor management personnel, and the Contracting Officer's representative will be in attendance at this inspection. Additional Government personnel may be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the "Pre-Final" inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final inspection stating that all specific items previously identified to the Contractor as being unacceptable, along with all the remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.15 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.15.1 Contractor Production Report

Reports are required for each day that work is performed and shall be attached to the Contractor Quality Control Report prepared for the same day. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Production Reports are to be prepared, signed and dated by the project superintendent and shall contain the following information:

a. Date of report, report number, name of contractor, Contract number, title and location of Contract and superintendent present.

b. Weather conditions in the morning and in the afternoon including maximum and minimum temperatures.

c. Identify work performed by corresponding Schedule Activity no., PC#, Modification No., etc.

d. A list of Contractor and subcontractor personnel on the work site, their trades, employer, work location, description of work performed, hours worked by trade, daily total work hours on work site, and total work hours from start of construction.

e. A list of job safety actions taken and safety inspections conducted. Indicate that safety requirements have been met including the results on the following:

(1) Was a job safety meeting held? (If YES, attach a copy of the meeting minutes.)

(2) Were there any lost time accidents? (If YES, attach a copy of the completed OSHA report.)

(3) Was crane/trenching/scaffold/high voltage electrical/high work done? (If YES, attach a statement or checklist showing inspection performed.)

(4) Was hazardous material/waste released into the environment? (If YES, attach a description of meetings held and accidents that happened.)

(5) List safety actions taken today and safety inspections conducted.

f. A list of equipment/material received each day that is incorporated into the job.

g. A list of construction and plant equipment on the work site including the number of hours used, idle and down for repair.

h. Include a "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

1.15.2 Contractor Quality Control Report

Reports are required for each day that work is performed and for every seven consecutive calendar days of no-work and on the last day of a no-work period. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Quality Control Reports are to be prepared, signed and dated by the QC Manager and shall contain the following information:

a. Identify the control phase and the definable feature of work.

b. Results of the Preparatory Phase meetings held including the location of the definable feature of work and a list of personnel present at the meeting. Indicate in the report that for this definable feature of work, the drawings and specifications have been reviewed, submittals have been approved, materials comply with approved submittals, materials are stored properly, preliminary work was done correctly, the testing plan has been reviewed, and work methods and schedule have been discussed, and that safety and hazard analysis was addressed.

c. Results of the Initial Phase meetings held including the location of the definable feature of work and a list of personnel present at the meeting. Indicate in the report that for this definable feature of work the preliminary work was done correctly, samples have been prepared and approved, the workmanship is satisfactory, test results are acceptable, work is in compliance with the Contract, work complies with safety requirements, and the required testing has been performed and include a list of who performed the tests.

d. Results of the Follow-up Phase inspections held including the location of the definable feature of work. Indicate in the report for this definable feature of work that the work complies with the Contract as approved in the Initial Phase, work complies with safety requirements, and that required testing has been performed and include a list of who performed the tests.

e. Results of the three phases of control for off-site work, if applicable, including actions taken.

f. List the rework items identified, but not corrected by close of business.

g. List the rework items corrected from the rework items list along with the corrective action taken.

h. Include a "remarks" section in this report which will contain pertinent information including directions received, quality control problem areas, deviations from the QC plan, construction deficiencies encountered, QC meetings held, acknowledgement that as-built drawings have been updated, corrective direction given by the QC Organization and corrective action taken by the Contractor.

i. Contractor Quality Control Report certification.

1.15.3 Quality Control Checklist

Maintain a Quality Control Checklist for each definable feature of work. Each control check should indicate whether or not the work performed complies with contract requirements. Work performed that does not comply with contract requirements shall be noted in the Rework Items list.

1.15.4 Reports from the QC Specialist(s)

Reports are required for each day that work is performed in their area of responsibility. QC specialist reports shall include the same documentation requirements as the Contractor Quality Control Report for their area of responsibility. QC specialist reports are to be prepared, signed and dated by the QC specialists and shall be attached to the Contractor Quality Control Report prepared for the same day.

1.15.5 Testing Plan and Log

As tests are performed, the QC Manager shall record on the "Testing Plan and Log" the date the test was conducted, the date the test results were forwarded to the Contracting Officer, remarks and acknowledgement that an accredited or Contracting Officer approved testing laboratory was used. Attach a copy of the updated "Testing Plan and Log" to the last daily Contractor Quality Control Report of each month.

1.15.6 Rework Items List

The QC Manager shall maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Rework Items List" to the last daily Contractor Quality Control Report of each month. The Contractor shall be responsible for including on this list items needing rework including those identified by the Contracting Officer.

1.15.7 As-Built Drawings

The QC Manager is required to ensure the as-built drawings, required by Section 01770, "Closeout Procedures," are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.).The QC Manager or QC specialist assigned to an area of responsibility shall initial each deviation and each revision. Upon completion of work, the QC Manager shall furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.15.8 Report Forms

The following forms, are acceptable for providing the information required by the paragraph entitled "Documentation." While use of these specific formats are not required, any other format used shall contain the same information:

a. Combined Contractor Production Report and Contractor Quality Control Report, with separate continuation sheet.

b. Testing Plan and Log.

c. Rework Items List.

1.16 NOTIFICATION ON NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Contractor.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

CONTRACTOR PRODUCTION REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE			
CONTRACT NO	TITLE AND LOCATION		REPORT NO
CONTRACTOR		SUPERINTENDENT	
AM WEATHER	PM WEATHER	MAX TEMP F	MIN TEMP F

WORK PERFORMED TODAY

Schedule Activity No.	WORK LOCATION AND DESCRIPTION	EMPLOYER	NUMBER	TRADE	HRS

JOB SAFETY

WAS A JOB SAFETY MEETING HELD THIS DATE? (If YES attach copy of the meeting minutes)	☐ YES ☐ NO	TOTAL WORK HOURS ON JOB SITE THIS DATE	
WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? (If YES attach copy of completed OSHA report)	☐ YES ☐ NO	CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT	
WAS CRANE/MANLIFT/TRENCHING/SCAFFOLD/HV ELECTRICAL/HIGH WORK DONE? (If YES attach statement or checklist showing inspection performed.)	☐ YES ☐ NO	TOTAL WORK HOURS FROM START OF CONSTRUCTION	
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? (If YES attach description of incident and proposed action.)	☐ YES ☐ NO		

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED

☐ SAFETY REQUIREMENTS HAVE BEEN MET.

EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB

CONSTRUCTION AND PLANT EQUIPMENT ON JOB SITE TODAY. INCLUDE NUMBER OF HOURS USED TODAY

REMARKS

CONTRACTOR/SUPERINTENDENT DATE

CONTRACTOR QUALITY CONTROL REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

PHASE	(BLANK NOT APPLICABLE)	YES	NO	IDENTIFY SPECIFICATION SECTION, DEFINABLE FEATURE OF WORK, LOCATION AND LIST PERSONNEL PRESENT
PREPARATORY	PLANS AND SPECS HAVE BEEN REVIEWED	☐	☐	
	THE SUBMITTALS HAVE BEEN APPROVED.	☐	☐	
	MATERIALS COMPLY WITH APPROVED SUBMITTALS	☐	☐	
	MATERIALS STORED PROPERLY.	☐	☐	
	PRELIMINARY WORK WAS DONE CORRECTLY.	☐	☐	
	TESTING PLAN HAS BEEN REVIEWED.	☐	☐	
	WORK METHOD AND SCHEDULE DISCUSSED.	☐	☐	
	JOB SAFETY / HAZARD ANALYSIS ADDRESSED	☐	☐	
INITIAL	PRELIMINARY WORK WAS DONE CORRECTLY	☐	☐	TESTING PERFORMED & WHO PERFORMED TEST
	SAMPLE HAS BEEN PREPARED/APPROVED	☐	☐	
	WORKMANSHIP IS SATISFACTORY	☐	☐	
	TEST RESULTS ARE ACCEPTABLE.	☐	☐	
	WORK IS IN COMPLIANCE WITH THE CONTRACT.	☐	☐	
	WORK COMPIES WITH SAFETY REQUIREMENTS	☐	☐	
FOLLOW-UP	WORK COMPLIES WITH CONTRACT AS APPROVED INITIAL PHASE	☐	☐	TESTING PERFORMED & WHO PERFORMED TEST
	WORK COMPIES WITH SAFETY REQUIREMENTS	☐	☐	

REWORK ITEMS IDENTIFIED TODAY (NOT CORRECTED BY CLOSE OF BUSINESS)

REWORK ITEMS CORRECTED TODAY (FROM REWORK ITEMS LIST)

REMARKS

On behalf of the contractor, I certify that this report is completed and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.

AUTHORIZED QC MANAGER AT SITE DATE

GOVERNMENT QUALITY ASSURANCE REPORT

DATE

QUALITY ASSURANCE REPRESENTATIVE'S REMARKS AND/OR EXCEPTIONS TO THE REPORT

GOVERNMENT QUALITY ASSURANCE MANAGER DATE

CONTRACTOR QUALITY CONTROL REPORT CONTINUATION SHEET (ATTACH ADDITIONAL SHEETS IF NECESSARY)				DATE
PHASE	(BLANK NOT APPLICABLE)	YES	NO	IDENTIFY SPECIFICATION SECTION, DEFINABLE FEATURE OF WORK, LOCATION AND LIST PERSONNEL PRESENT
PREPARATORY	PLANS AND SPECS HAVE BEEN REVIEWED	☐	☐	
	THE SUBMITTALS HAVE BEEN APPROVED.	☐	☐	
	MATERIALS COMPLY WITH APPROVED SUBMITTALS	☐	☐	
	MATERIALS STORED PROPERLY.	☐	☐	
	PRELIMINARY WORK WAS DONE CORRECTLY.	☐	☐	
	TESTING PLAN HAS BEEN REVIEWED.	☐	☐	
	WORK METHOD AND SCHEDULE DISCUSSED.	☐	☐	
	JOB SAFETY / HAZARD ANALYSIS ADDRESSED	☐	☐	

PHASE		YES	NO		TESTING PERFORMED & WHO PERFORMED TEST
INITIAL	PRELIMINARY WORK WAS DONE CORRECTLY	☐	☐		
	SAMPLE HAS BEEN PREPARED/APPROVED	☐	☐		
	WORKMANSHIP IS SATISFACTORY	☐	☐		
	TEST RESULTS ARE ACCEPTABLE.	☐	☐		
	WORK IS IN COMPLIANCE WITH THE CONTRACT.	☐	☐		
	WORK COMPLIES WITH SAFETY REQUIREMENTS	☐	☐		

CONTRACTOR QUALITY CONTROL REPORT CONTINUATION SHEET (ATTACH ADDITIONAL SHEETS IF NECESSARY)				DATE
PHASE	(BLANK NOT APPLICABLE)	YES	NO	IDENTIFY SPECIFICATION SECTION, DEFINABLE FEATURE OF WORK, LOCATION AND LIST PERSONNEL PRESENT
FOLLOW-UP	WORK COMPLIES WITH CONTRACT AS APPROVED INITIAL PHASE	☐	☐	
	WORK COMPLIES WITH SAFETY REQUIREMENTS	☐	☐	

COMBINED FORM 01450-2 (7/96)

REWORK ITEMS LIST

Contract No. and Title: ______________________________

Contractor: ______________________________

NUMBER	DATE IDENTIFIED	DESCRIPTION	CONTRACT REQUIREMENT (Spec. Section and Par. No., Drawing No. and Detail No., etc.)	ACTION TAKEN BY QC MANAGER	RESOLUTION	DATE COMPLETED

TESTING PLAN AND LOG

CONTRACT NUMBER			PROJECT TITLE AND LOCATION							CONTRACTOR	
SPECIFICATION SECTION AND PARAGRAPH NUMBER	ITEM OF WORK	TEST REQUIRED	ACCREDITED/ APPROVED LAB		SAMPLED BY	TESTED BY	LOCATION OF TEST		DATE COMPLETED	DATE FORWARDED TO CONTR. OFF.	REMARKS
			YES	NO			ON SITE	OFF SITE			

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C510	(1992) Double Check Valve Backflow-Prevention Assembly
AWWA C511	(1992) Reduced-Pressure Principle Backflow-Prevention Assembly

FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA MUTCD	(1988) Manual on Uniform Traffic Control Devices

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULICRESEARCH (FCCCHR)

FCCCHR USC	(1992) List of Approved Backflow Prevention Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1994; Errata 1995) Portable Fire Extinguishers
NFPA 70	(1996) National Electric Code
NFPA 241	(1996) Safeguarding Construction, Alteration, and Demolition Operations

1.2 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Backflow preventers

1.2.2 SD-04, Drawings

a. Traffic control plan G

1.2.3 SD-13, Certificate

a. Backflow preventers Certificate of Full Approval

1.2.3.1 Backflow Preventers Certificate

Certificate of Full Approval from FCCCHR USC, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.2.4 SD-12, Field Test Reports

a. Test results

1.3 TEMPORARY UTILITIES

Reasonable amounts of electricity and water will be made available to the Contractor without charge.

The point at which the Government will deliver such utilities or services and the quantity available shall be as directed by the Contracting Officer. The Contractor shall pay all costs incurred in connecting, converting, and transferring the utilities to the work. The Contractor shall make connections, including providing backflow-preventing devices on connections to domestic water lines; providing meters and providing transformers; and making disconnections.

1.4 WEATHER PROTECTION

Take necessary precautions to ensure that critical openings in the construction are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment from damage.

1.4.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions shall include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

1.4.1.1 Hurricane Condition of Readiness

Unless directed otherwise, comply with:

a. Condition FOUR (Sustained winds of 93 km/hr or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 1 m high. Remove all debris, trash, or objects that could become missile hazards. Contact ROICC for Condition of Readiness (COR) updates and completion of required actions.

b. Condition THREE (Sustained winds of 93 km/hr or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness. Contact ROICC for weather and COR updates and completion of required actions.

c. Condition TWO (Sustained winds of 93 km/hr or greater expected within 24 hours): Curtail or cease routine activities until securing operation is complete. Reinforce or remove form work and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact ROICC for weather and Condition of Readiness (COR) updates and completion of required actions.

d. Condition ONE. (Sustained winds of 93 km/hr or greater expected within 12 hours): Secure the jobsite, and leave Government premises.

1.5 STATION OPERATION AFFECT ON CONTRACTOR OPERATIONS

1.5.1 Special Restrictions Regarding Access of Vehicles and Parking

1.5.1.1 Interruption of Vehicular Traffic

If during the performance of work, it becomes necessary to modify vehicular traffic patterns at any locations, notify the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan shall be in accordance with State and local regulations and the FHWA MUTCD, Part VI. Make all notifications and obtain any permits required for modification to traffic movements outside Station's jurisdiction. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic.

1.5.1.2 Commercial Vehicles In/Out of NAVSTA/NAS Norfolk, VA

a. Definitions. Commercial vans and trucks are differentiated as follows:

(1) Closed truck. A truck enclosed on four sides, top, and bottom to which entry can be made only through end or side doors and to which a seal can be applied.

(2) Open truck. A truck which is either fully open, such as flatbed, or contained by wooden slats or sideboards; or any truck to which a seal cannot be applied.

(3) Commercial vehicles. A common contract or commercial truck without a decal issued by Norfolk, VA.

(4) Trailer. A non-self-propelled enclosed cargo container used for the transportation of goods, e.g., a trailer pulled by a truck.

b. Instructions and directions. Ensure that commercial trucks and trailers follow the instructions below to provide for effective control over their entry and exit from the base, movement within the base, and to reduce congestion both at the gates and within the base. In general, commercial trucks and common carriers are required to enter and exit through specified gates and process immediately to a truck control point for cargo manifest check. The driver shall be issued a Material Movement Control and Gate Pass, routing instructions, and directions to depart the base via a designated exit point where the pass is to be turned in.

(1) Common contract and commercial trucks going to the area of Building LP-84 (MAC Terminal), NAS Norfolk shall enter and exit Gate 22. Gate 22 hours of operations are 5:30 a.m. through 6:30 p.m. and 10:30 p.m. through 3:00 a.m., 7 days a week. The gate is closed on holidays.

(2) Other common contract and commercial trucks, except as noted below are allowed to enter the Naval Base through any Gate and exit through Gate 2.

(3) Common contract and commercial trucks which enter the base may depart through Gate 5, Gate 4, and Gate 22 only. The exit Truck Control Point at Gate 4 is operated from 7:00 a.m. to 5:00 p.m.

(4) For concrete- and asphalt-carrying trucks, the Resident Officer in Charge of Construction (ROICC), Norfolk, VA shall arrange entry and exit through any gate other than Gate 2.

(5) Contractor vehicles with black Norfolk Naval Base decals shall be granted routine access to the base at all times. These trucks shall not enter or exit the base through Gate 2. These trucks are subject to random checks and searches at exit gates like other personal and commercial vehicles to ensure that Government property is not being taken off the base without authorization and documentation.

c. Movement and Exit

(1) Material movement control and gate pass. A Material Movement Control and Gate Pass (5ND GEN 5510/1) is required for the removal of Government, public, or private property from NAVSTA and NAS Norfolk complex via commercial vans and truck.

(a) The Material Movement Control and Gate Pass shall be originated by the Naval Base Police Truck Control Officer, and shall be given to drivers of commercial trucks for retention during transit to intermediate stops and to the exit gates. The pass shall be presented by the driver to the Truck Control Officer at the exit truck stop. If the driver has more than one delivery or pickup point, the driver shall present the pass at each stop so the new activity may fill in appropriate information on the pass. A copy of the pass shall be retained by each activity after appropriate information has been entered; remaining copies of the pass shall be returned to the driver. Passes are subject to review by the Naval Base Police Department during transit and within command areas by activity officials for verification of cargo content and to determine if drivers are transiting promptly and by the proper route. For trailers expecting to be picked up and depart outside normal working hours, pre-prepared passes shall be provided by the activity duty officer or authorized supervising person prior to close of working hours. Trucking companies expecting to pick up trailers after working hours should be instructed to pick up a Material Movement Control and Gate Pass from the responsible activity. The activity duty officer or official shall notify Base Police Headquarters to clear the truck for exit at Gate 5 if the seal and Material Movement Control and Gate Pass are in order.

(b) When filling out a Material Movement Control and Gate Pass, the last activity where business is conducted on the base is responsible to ensure that the original of the pass is given to the driver to turn in to the Truck Control officer at the truck control stops.

(c) The Material Movement Control and Gate Pass shall be turned in by the vehicle driver to a base police officer at a truck control stop when he departures from the base.

(d) Government or commercial vehicles departing Naval Base, Norfolk with Government, public, or private property shall possess a Material Movement Control and Gate Pass filled out by a naval officer or equivalent grade civilian within the driver's chain of command. The Material Movement Control and Gate Pass shall be inspected and verified during random gate departure searches.

(2) Car Seals

(a) Commercial, sealable, closed trailers and trucks, full, partially full, or empty, destined to leave the base shall be sealed upon departure from any activity. The seal number and trailer or truck number shall be entered on the Material Movement Control and Gate Pass.

(b) Commercial closed trailers and trucks received empty for loading with Government material shall have a Navy car seal affixed to cargo doors after loading and prior to departing through designated gates.

(c) Closed trailers and trucks which have been only partially loaded or off-loaded shall be sealed completely at the end of working hours with a Navy car seal.

(d) Application of Navy car seals is the responsibility of the activity in charge of loading and unloading of trailers and trucks.

(e) The Naval Base Police Department will conduct random checks of contents, seals, and forms of trailers and trucks on the Naval Base complex.

(f) A truck driver whose van or truck does not have a properly completed Material Movement Control and Gate Pass or car seal will be refused exit clearance.

1.6 STORAGE AREAS

The Contract Clause entitled "FAR 52.236-10, Operations and Storage Areas" and the following apply:

1.6.1 Contractor's Use of Bldg. Z-86

The Contractor will be allowed to use the ground floor of Bldg. Z-86 for office and storage space until December of 1999. Exact limits of space will be as directed by the Contracting Officer. After December of 1999 the Contractor will have full use of the building.

1.6.2 Storage Size and Location

The open site available for storage shall be as indicated.

1.7 TEMPORARY SANITARY FACILITIES

Provide adequate sanitary conveniences of a type approved for the use of persons employed on the work, properly secluded from public observation, and maintained in such a manner as required and approved by the Contracting Officer. Maintain these conveniences at all times without nuisance. Upon completion of the work, remove the conveniences from the premises, leaving the premises clean and free from nuisance. Dispose of sewage through connection to a municipal, district, or station sanitary sewage system. Where such systems are not available, use chemical toilets or comparably effective units, and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Include provisions for pest control and elimination of odors.

1.8 TEMPORARY BUILDINGS

Locate these where directed and within the indicated operations area.

1.8.1 Maintenance of Temporary Facilities

Suitably paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

1.8.2 Trailers or Storage Buildings

Trailers or storage buildings will be permitted, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 600 by 600 mm shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

1.8.2.1 Trailer Sign

A sign that conforms to the following requirements and sketch shall be mounted on the trailer or building that shows the company name, phone number, and emergency phone number.

Sign requirements:

Graphic panel: Aluminum, painted blue

Copy: Screen painted or vinyl die-cut, white

Typeface: Univers 65 u/lc

See Sketch No. 01500 (graphic)

PART 2   PRODUCTS

2.1   Backflow Preventers

Reduced pressure principle type conforming to the applicable requirements AWWA C510 and AWWA C511. Provide backflow preventers complete with 65 kg flanged cast iron, bronze or brass mounted gate valve and strainer, 304 stainless steel or bronze, internal parts. Listing of particular make, model/design, and size in FCCCHR USC will be acceptable as required proof for testing and certification.

PART 3   EXECUTION

3.1   TEMPORARY PHYSICAL CONTROLS

3.1.1   Access Controls

3.1.1.1   Temporary Barricades

Contractor shall provide for barricading around all work areas to prevent public access.

3.1.1.2   Fencing

Fencing shall be provided along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 90 kg against it.

3.1.1.3   Signs

Place warning signs at the construction area perimeter designating the presence of construction hazards requiring unauthorized persons to keep out. Signs must be placed on all sides of the project, with at least one sign every 90 m. All points of entry shall have signs designating the construction site as a hard hat area.

3.1.1.4   Traffic Work

All work around/involving roadways, to include roadway excavations and utility crossings, will be conducted in accordance with Manual of Traffic Control Devices. Contractors shall provide and ensure appropriate road closure and detour signs are established as necessary for motor traffic management. All road closures shall be coordinated with the Contracting Officer in advance. Self-illuminated (lighted) barricades shall be provided during hours of darkness. Brightly-colored (orange) vests are required for all personnel working in roadways. Road closures shall require a road closure plan showing the location of signage.

3.2   TEMPORARY WIRING

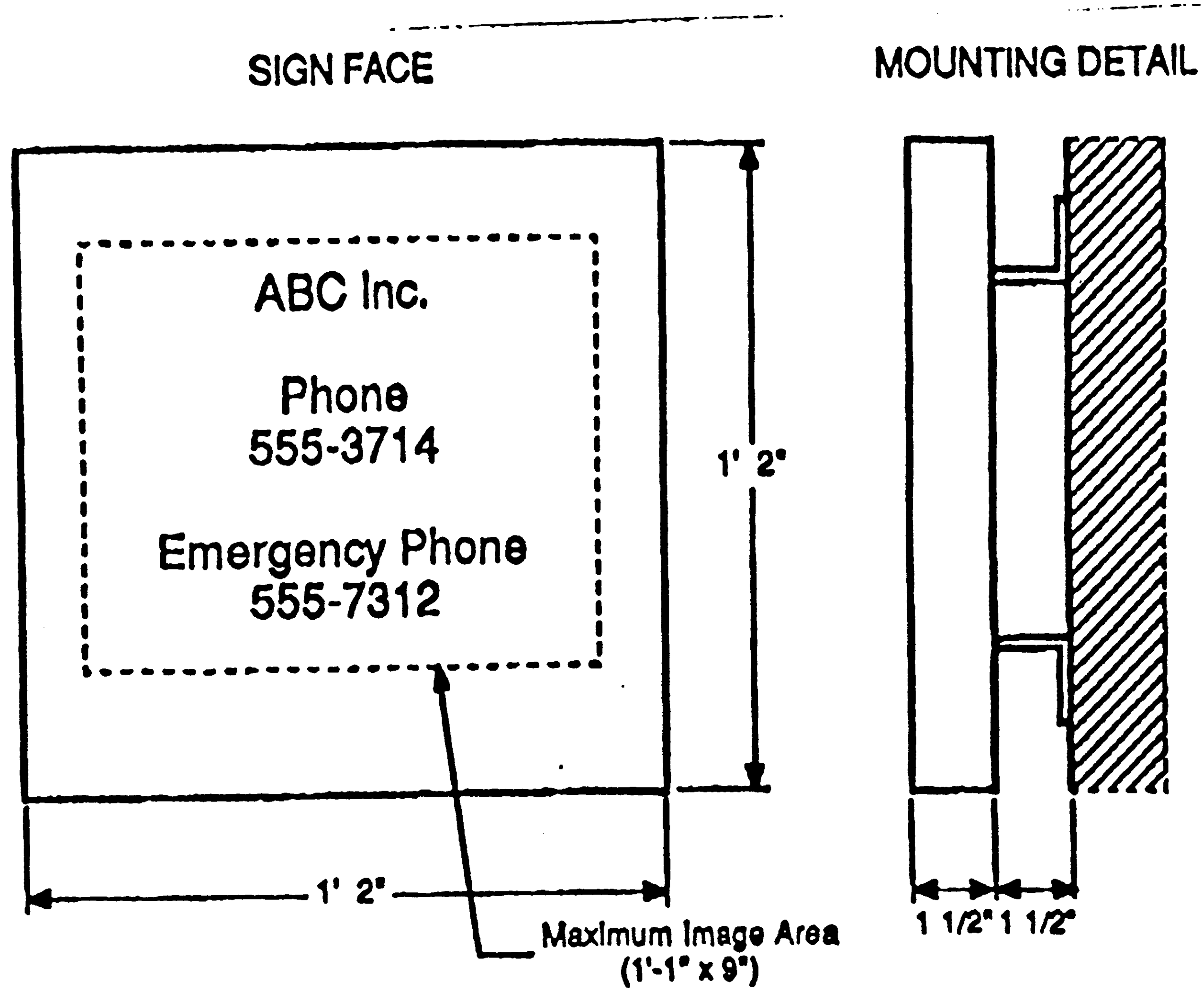
Provide temporary wiring in accordance with NFPA 10, NFPA 241, and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Program shall include frequent inspection of all equipment and apparatus.

3.3 REDUCED PRESSURE BACKFLOW PREVENTERS

Install the reduced pressure backflow device on each discharge point at which water is obtained. Connections to test cocks or the use of wye connectors is not acceptable.

Tag and test each principle reduced pressure backflow device monthly by a certified tester. Tag shall contain the following: make, model, serial number, dates of tests, results, maintenance performed, and signature of tester. Submit test results.

-- End of Section --



Sign requirements:

Graphic panel: Aluminum, painted blue
Copy: Screen painted or vinyl die-cut, white
Typeface: Univers 65 u/lc

SKETCH NO. SK-01500-1

SECTION 01525

SAFETY REQUIREMENTS
09/97

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Related Sections

a. Section 01310, "Administrative Requirements"

b. Section 01500, "Temporary Facilities and Controls"

c. Section 13281, "Engineering Control of Asbestos Containing Materials"

d. Section 13282, "Removal and Disposal of Painted Building Surfaces Containing Lead"

e. Section 13286, "Handling of Lighting Ballasts and Lamps Containing PCB's and Mercury"

f. Section 02220, "Site Demolition"

g. Section 02315, "Excavation and Fill"

h. Section 03300, "Cast-in-place Concrete"

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.14	(1991) Construction and Demolition Operations - Requirements for Safety Belts, Harnesses, Lanyards and Lifelines for Construction and Demolition Use
ANSI Z359.1	(1992) Safety Requirements for Personal Fall Arrest Systems

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.94	Ventilation
29 CFR 1926.502(f)	Warning Line Systems

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1996) Safety and Health Requirements Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electric Code
NFPA 241	(1996) Safeguarding Construction, Alteration, and Demolition Operations

1.3 DEFINITIONS

a. Certified Industrial Hygienist. An industrial hygienist is an individual who is certified by the American Board of Industrial Hygiene.

b. Certified Safety Professional. A safety manager, safety specialist, or safety engineer that has passed the CSP exam administered by the Board of Certified Safety Professionals.

c. Confined Space. A space which by design has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy, engulfment or any other recognized safety or health hazard. Confined spaces include, but are not limited to storage tanks, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.

d. Multi-employer work site (MEWS). The prime contractor is the "controlling authority" for all work site safety and health of the subcontractors.

e. Recordable Occupational Injuries or Illness. An occupational injury or illnesses which result in serious injuries, lost workday cases, non-fatal cases or significant mishaps.

f. Serious Injuries & Fatalities. Regardless of the time between the injury and death or the length of the illness; hospitalization of three or more employees; or property damage in excess of $200,000.

g. Lost Workday Cases. Injuries, other than fatalities, that result in lost workdays.

h. Non-Fatal Cases. Cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid) or involve property damage in excess of $10,000 but less than $200,000 or involve: loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as facilities or lost workday cases.

i. Safety Officer. The superintendent or other qualified or competent person who is responsible for the on-site safety required for the project. The contractor quality control person cannot be the safety officer, even through the QC has safety inspection responsibilities as part of the QC duties.

j. Significant Contractor Mishap. A contractor mishap which involves falls of 1200 mm or more, electrical mishaps, confined space mishaps, diving mishaps, equipment mishaps, and fire mishaps which result in a lost time injury, or property damage of $10,000 or more, but less than $200,000; or when fire department or emergency medical treatment (EMT) assistance is required.

k. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment provided by a physician or registered personnel.

l. First Aid. A one-time treatment, and follow-up visit for the purpose of observation, of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care, even though provided by a physician or registered professional personnel.

m. Lost Workdays. The number of days (consecutive or not) after, but not including, the day of injury or illness during which the employee would have worked but could not do so; that is, could not perform all or part of his normal assignment during all or any part of the workday or shift; because of the occupational injury or illness.

1.4 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.4.1 SD-08, Statements

a. Accident prevention plan (APP) G

b. Activity Hazard Analysis (AHA) G

1.4.1.1 Accident Prevention Plan (APP)

Submit at least 15 calendar days prior to start of work at the job site, follow Appendix A of COE EM-385-1-1, make APP site specific, Notice To Proceed will be given after Government finds the APP acceptable.

1.4.1.2 Activity Hazard Analysis (AHA)

Submit the AHA for the preparatory phase as a part of the APP. Submit subsequent AHA for each major phase of work at least 15 calendar days prior to the start of that phase. Format subsequent AHA as amendments to the APP.

1.4.2 SD-18, Record

a. Daily Confined Space Entry Permit. Submit one copy of each permit attached to each Daily Production Report.

b. Reports. Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

a. Qualifications of Safety Officer:

(1) Ability to manage the on-site contractor safety program through appropriate management controls,

(2) Ability to identify hazards and have the capability to expend resources necessary to abate the hazards.

(3) Must have worked on similar types of projects that are equal to or exceed the scope of the project assigned with the same responsibilities.

b. Qualifications of Qualified Person, Confined Space Entry. The qualified person shall be capable (by education and specialized training) of anticipating, recognizing, and evaluating employee exposure to hazardous substances or other unsafe conditions in a confined space. This person shall be capable of specifying necessary control and protective action to ensure worker safety.

c. Qualification of Crane Operators. Crane operators shall meet the requirements in COE EM-385-1-1, Appendix G.

1.5.2 Qualifications of Qualified Person, Confined Space Entry

The qualified person shall be capable (by education and specialized training) of anticipating, recognizing, and evaluating employee exposure to hazardous substances or other unsafe conditions in a confined space. This person shall be capable of specifying necessary control and protective action to ensure worker safety.

1.5.3 Qualification of Crane Operators

Crane operators shall meet the requirements in COE EM-385-1-1, Appendix G.

1.5.4 Meetings

1.5.4.1 Preconstruction Conference

The safety officer shall attend the preconstruction conference required by Section 01310, "Administrative Requirements."

1.5.4.2 Weekly Safety Meetings

Hold weekly. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the QC Contractor Quality Control daily report.

1.6 ACCIDENT PREVENTION PLAN (APP)

Prepare the APP in accordance with the required and advisory provisions of COE EM-385-1-1 including Appendix A, "Minimum Basic Outline for Preparation of Accident Prevention Plan," and as modified herein. Include the associated AHA and other specific plans, programs and procedures listed on Pages A-3 and A-4 of COE EM-385-1-1, some of which are called out below.

1.6.1 Contents of the Accident Prevention Plan

a. Name and safety related qualifications of safety officer (including training and any certifications).

b. Qualifications of competent and of qualified persons.

c. Identify of the individual who will complete exposure data (hours worked); accident investigations, reports and logs; and immediate notification of accidents to include subcontractors.

d. Emergency response plan. Conform to COE EM-385-1-1, paragraph 01.E and include a map denoting the route to the nearest emergency care facility with emergency phone numbers. Contractor may be required to demonstrate emergency response.

e. Confined Space Entry Plan. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

f. Hazardous Energy Control Plan. For hazardous energy sources, comply with COE EM-385-1-1, paragraph 12.A.07.

g. Critical Lift Procedures. Weight handling critical lift plans will be prepared and signed in accordance with COE EM-385-1-1, paragraph 16.c.18.

h. Alcohol and Drug Abuse Plan

(1) Describe plan for random checks and testing with pre-employment screening in accordance with the DFAR Clause subpart 252.223-7004, "Drug Free Work Force."

(2) Description of the on-site prevention program

i. Fall Protection Plan. The plan shall be site specific and protect all workers at elevations above 1800 mm .

j. Silica Exposure Reduction. The plan shall include specific procedures to prevent employee silica inhalation exposures.

k. Lead Abatement Plan. The safety and health aspects of lead-based paint removal, prepared in accordance with Section 13283, "Removal and Disposal of Lead Containing Paint".

l. Asbestos Abatement Plan. The safety and health aspects prepared in accordance with Section 13281, "Engineering Control of Asbestos Containing Materials"

m. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02220, "Site Demolition"

1.7 ACTIVITY HAZARD ANALYSIS (AHA)

Prepare for each phase of the work. As a minimum, define activity being performed, sequence of work, specific hazards anticipated, control measures to eliminate or reduce each hazard to acceptable levels, training requirements for all involved, and the competent person in charge of that phase of work. For work with fall hazards, including fall hazards associated with scaffold erection and removal, identify the appropriate fall arrest systems. For work with materials handling equipment, address safeguarding measures related to materials handling equipment. For work requiring excavations, include excavation safeguarding requirements. The appropriate AHA shall be reviewed and attendance documented by Contractor at the preparatory, initial, and follow-up phases of Quality Control inspection.

1.8 DRUG PREVENTION PROGRAM

Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employees either use illegal drugs or consume alcohol during work hours. Ensure no employees under the influence of drugs or alcohol during work hours. After accidents, collect blood, urine or saliva specimens and test injured employee influence. A copy of the test shall be made available to the Contracting Officer upon request.

1.9 FALL HAZARD PREVENTION PROGRAM

1.9.1 Scaffolds

Delineate the fall protection requirements necessary during the erection and dismantling operation of scaffolds used on the project in the fall protection plan and activity hazard analysis for the phase of work.

1.9.2 Training

Institute a fall protection program. As part of the Fall Protection Program, contractor shall provide training for each employee who might be exposed to fall hazards.

1.10 DUTIES OF THE SAFETY OFFICER

a. Ensure construction hazards are identified and corrected.

b. Maintain applicable safety reference material on the job site.

c. Maintain a log of safety inspections performed.

d. Attend the pre-construction conference required by Section 01310, "Administrative Requirements."

1.11 DISPLAY OF SAFETY INFORMATION

Display the following information in clear view of the on-site construction personnel:

a. Map denoting the route to the nearest emergency care facility with emergency phone numbers.

b. AHA

c. Confined space entry permit.

1.12 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturers' manuals.

1.13 HIGH HAZARD WORK AND LONG DURATION

Work under this contract is potentially hazardous. Pursuant to contract clause "FAR 52.236-13, Accident Prevention, Alternate I," submit in writing additional proposals for effecting accident prevention under hazardous conditions. Meet in conference with Contracting Officer to discuss and develop mutual understanding relative to the administration of the overall safety program.

1.14 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide. However, if emergency medical care is rendered by Navy medical services, charges may be billed to Contractor at prevailing rates established in BUMED Instruction 6320.4 series. Reimbursement shall be made by Contractor to Naval Regional Medical Center Collection Agent upon receipt of monthly statement.

1.15 REPORTS

1.15.1 Reporting Reports

For OSHA recordable accidents, the prime contractor will conduct a suitable investigation, complete the Navy Contractor Significant Incident Report (CSIR) form and provide to the Contracting Officer within 5 calendar days of the accident.

1.15.2 Notification

Notify Contracting Officer, within 4 hours, of any accident meeting the definition of OSHA recordable occupational injury or illness. Information shall include Contractor name; contract title; type of contract; name of activity, installation or location where mishap occurred; date and time of mishap; names of personnel injured; extent of property damage, if any; and brief description of mishap (to include type of construction equipment used, PPE used, etc.) In addition to OSHA reporting requirements, initial notification shall be made of any accident involving significant mishaps.

1.15.3 Monthly Exposure Report

Monthly exposure reporting, to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor.

1.15.4 OSHA Citations and Violations

Provide the Contracting Officer with a copy of each OSHA citation, OSHA report and Contractor response. Correct violations and citations promptly and provide written corrective actions to the Contracting Officer.

PART 2 PRODUCTS

2.1 FALL PROTECTION ANCHORAGE

Fall protection anchorages, used by contractors to protect their people, will be left in place and so identified for continued customer use.

2.2 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new confined spaces. Signs wording: "DANGER--PERMIT REQUIRED CONFINED SPACE - DO NOT ENTER -" on bold letters a minimum of 25 mm in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" and shall be red and readable from 1.52 m .

PART 3 EXECUTION

3.1 CONSTRUCTION

Comply with COE EM-385-1-1, NFPA 241, the accident prevention plan, the activity hazard analysis and other related submittals and activity fire and safety regulations.

3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. Exceptions to the use of any of the above excluded materials may be considered by Contracting Officer upon written request by Contractor.

3.1.2 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and nonfriable asbestos. If additional material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages a minimum of 15 days in advance. As a minimum, the request should include the location of the outage, utilities being effected, duration of outage and any necessary sketches. Once approved and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the ROICC and the Station Utilities Department to review the scope of work and the lock out/tag out procedures for worker protection.

3.3 PERSONNEL PROTECTION

3.3.1 Hazardous Noise

Provide hazardous noise signs, and hearing protection, where ever equipment and work procedures produce sound-presssure levels greater than 85 dBA steady state or 140 dBA impulse, regardless of the duration of the exposure.

3.3.2 Fall Protection

Enforce use of the fall protection device named for each activity in the AHA all times when an employee is on a surface 1800 mm or more above lower levels. Personal fall arrest systems are required when working from an articulating or extendible boom, scissor lifts, swing stages, or suspended platform. Fall protection must comply with ANSI A10.14.

3.3.2.1 Personal Fall Arrest Device

Equipment, subsystems, and components shall meet ANSI Z359.1, Personal Fall Arrest Systems. Only an full-body harness with a shock absorbing lanyard is an acceptable personal fall arrest device. Body belts may only be used as positioning devices only such as for steel reinforcing assembly. Body belts are not authorized as a personal fall arrest device. Harnesses must have upper middle back "D" rings for proper body suspension during a fall. Lanyard must be fitted with a double locking snap hook attachment. Webbing, straps, and ropes must be of synthetic fiber or wire rope.

3.3.2.2 Fall Protection for Roofs

a. For work within 1800 mm of an edge, on low pitched roofs, personnel shall be protected by use of personal fall arrest systems, guardrails, safety nets. Safety monitoring system is not adequate fall protection and is not authorized.

b. For work greater than 1800 mm from an edge, warning lines shall be erected and installed in accordance with 29 CFR 1926.502(f).

c. Work on steep roofs requires personal fall arrest, guardrails with toeboards, or safety nets. This requirement includes residential or housing type construction.

3.3.2.3 Safety Nets

Safety nets shall be provided in unguarded workplaces over water, machinery, dangerous operations, or more than 7.5 meters above surface.

3.3.3 Scaffolding

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Contractor shall ensure that scaffold erection is performed by employees that are qualified. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection plan. Minimum platform size shall be based on the platform not being greater in height than four times the dimension of the smallest width dimension for rolling scaffold. Some Baker type scaffolding has been found not to meet these requirements. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. The first tie-in shall be at the height equal to 4 times the width of the scaffold base.

3.3.4 Use of Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufactures printed operating instructions. Crane supported work platforms shall only be used in extreme conditions if the Contractor proves that using any other access to the work location would provide a greater hazard to the workers.

b. Cranes must be equipped with Load Indicating Devices , anti-two blocks devices, load, boom angle moment indicating indicators.

c. Christmas-tree lifting (multiple rigged materials) is not allowed.

3.3.5 Excavations

The competent person for excavation shall be on site when work is being performed in excavation, and shall inspect excavations prior to entry by workers. Individual must evaluate for all hazards, including atmospheric, that may be associated with the work, and shall have the resources necessary to correct hazards promptly.

3.3.6 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cable intended to be cut must be positively identified and de-energized prior to performing each cut. Perform all high voltage cutting remotely. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personnel protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. Insulating blankets, hearing protection, and switching suits may be required, depending on the specific job and as delineated in the Contractor AHA.

3.3.7 Work in Manholes

Contractor shall provide mechanical ventilation for all work accomplished in manholes, unless other hazards are present like friable asbestos.

3.3.8 Work in Confined Spaces

Comply with the requirements in Section 06.I of COE EM-385-1-1. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.05 of COE EM-385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained.

c. Ensure the use of rescue and retrieval devices in confined spaces greater than 1500 mm in depth. Conform to Sections 06.I.09, 06.I.10 and 06.I.11 of COE EM-385-1-1.

d. Sewer west walls require continuous atmosphere monitoring with audible alarm for toxic gas detection.

e. Include training information for employees who will be involved as entrant attendants for the work. Conform to Section 06.I.06 of COE EM-385-1-1.

f. Entry Permit. Use ENGFORM 5044-R or other form with the same minimum information for the Daily Confined Space Entry Permit, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

3.3.9 Crystalline Silica

Grinding, abrasive blasting, and foundry operations of construction materials containing crystalline silica, shall comply with OSHA regulations, such as 29 CFR 1910.94, and COE EM-385-1-1, (Appendix C). The Contractor shall develop and implement effective exposure control and elimination procedures to include dust control systems, engineering controls, and establishment of work area boundaries, as well as medical surveillance, training, air monitoring, and personal protective equipment.

3.4 ACCIDENT SCENE PRESERVATION

For serious accidents, ensure the accident site is secured and evidence is protected remaining undisturbed until released by the Contracting Officer.

3.5 FIELD QUALITY CONTROL

3.5.1 Inspections

Include safety inspection as a part of the daily Quality Control inspections required in Section 01450, "Quality Control."

-- End of Section --

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SECTION 01561
EROSION AND SEDIMENT CONTROL
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile

VIRGINIA SOIL AND WATER CONSERVATION COMMISSION (VSWCC)

VSWCC VESCH	(1992) Virginia Erosion and Sediment Control Handbook

1.2 DESCRIPTION OF WORK

The work includes the provision of temporary and permanent erosion control measures to prevent the pollution of air, water, and land within the project limits and in areas outside the project limits where work is accomplished in conjunction with the project.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Sediment Fence

b. Dust Suppressors

c. Erosion Control Matting

d. Filter Cloth Underliner

1.3.2 SD-04 Drawings

a. Erosion Control Plan G

1.3.3 SD-08 Statements

a. Construction Sequence Schedule G

1.3.3.1 Construction Sequence Schedule

Submit a Contractor furnished construction work sequence schedule, a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures to reduce on site erosion and off site sedimentation. Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and pollution.

1.4 EROSION CONTROL PLAN FOR VIRGINIA

The erosion control plan indicated has been approved. No additional review and approval is required, unless the Contractor desires to modify the erosion control plan indicated. All modifications shall be submitted to, and approved by, the Resident Officer in Charge of Construction prior to start of construction. The Contractor shall be responsible for any additional costs and time incurred as a result of the modifications to the approved erosion control plan. Provide and maintain erosion control measures in accordance with VSWCC VESCH, and as specified herein.

PART 2 PRODUCTS

2.1 SEDIMENT FENCE

2.1.1 State Standard Sediment Fence

VSWCC VESCH Standard 3.05, silt fence (maximum height of 864 mm).

2.2 SILT FENCE DROP INLET PROTECTION

2.2.1 State Standard Drop Inlet Protection

VSWCC VESCH Standard 3.07.

2.3 CONSTRUCTION ENTRANCE

2.3.1 State Standard Construction Entrance

2.3.1.1 Aggregate

VSWCC VESCH Standard 3.02.

2.3.1.2 Filter Cloth Underliner

A woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from ultraviolet, and with the following properties:

a.	Minimum grab tensile strength (ASTM D 4632)	.9 kN
b.	Minimum grab elongation (ASTM D 4632) at failure	15 percent
c.	Minimum mullen burst strength (ASTM D 3786)	2.96 MPa
d.	E.O.S. (ASTM D 4751)	40-80

2.4 DUST SUPPRESSORS

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.5 TEMPORARY SEEDING

2.5.1 State Standard Temporary Seeding

Provide seed, lime, and fertilizer in accordance with VSWCC VESCH Standard 3.31. Provide hay or straw mulch.

2.6 EROSION CONTROL MATTING

Jute, excelsior, or paper matting that has not been bleached or dyed. Provide matting in minimum 1.2 meter widths. Staples for anchoring the matting shall be minimum 11 gage wire, formed into a "U" shape with a minimum throat width of 25.4 mm and minimum length of 152 mm after forming.

2.6.1 Jute Matting

A uniform open plain weave of single jute yarn providing an average weight of .5 kg per square meter of matting. Yarn shall be of a loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Matting shall have openings between strands length wise of 11 to 19 mm, and between strands crosswise of 17 to 29 mm.

2.6.2 Excelsior Matting

A machine produced mat of wood excelsior with a minimum of 80 percent of wood fibers 152 mm in length or longer. The matting shall have an average weight of .41 to .46 kg per square meter with an even fiber distribution producing a consistent mat thickness, and shall have on one side a woven fabric. The woven fabric shall be twisted paper cord, cotton cord, or an extruded plastic mesh with a minimum mesh size of 25 by 25 mm and a maximum mesh size of 38 by 76 mm.

2.6.3 Paper Matting

Shall be a knitted polypropylene yarn with uniform openings with biodegradable paper strips continuously interwoven. The matting shall weigh a minimum of .05 kg per square meter with maximum openings of 19 mm and minimum openings of 13 mm.

2.6.4 Straw Matting

A machine produced straw mat with a minimum thickness of 13 mm +/- 3 mm. The straw shall be evenly distributed throughout the mat to provide a minimum average dry weight of . The topside of the mat shall be covered with a 9 mm biodegradable plastic mesh, with the mesh attached to the straw by a knitting process using biodegradable thread.

PART 3 EXECUTION

3.1 CONSTRUCTION SEQUENCE SCHEDULE

Stabilize areas for construction access immediately with gravel. Install principal sediment fences before any major site grading takes place.

Provide additional sediment fences as grading progresses. Provide drop inlet protection around existing drainage structures, and inlet and outlet protection at the ends of new drainage systems. Stabilize graded and disturbed areas immediately after grading. Permanent stabilization shall be provided immediately on areas that have been final graded. Temporary seeding and mulching shall be provided on disturbed areas as specified in the paragraph titled "Temporary Seeding." Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and sediment deposition. Remove temporary erosion control measures at the end of construction and provide permanent seeding.

3.2 SEDIMENT FENCES

Install posts a maximum of 1829 mm on center, and at an angle between 2 degrees and 20 degrees towards the potential silt load area. Sediment fence height shall be approximately 864 mm. Do not attach filter fabric to existing tree. Secure filter fabric to the post using staples, tie wire, or hog rings. Imbed the filter fabric into the ground. Splice filter fabric at support pole using a 6 inch overlap and securely seal. Top of the filter fabric shall have a 1 inch tuck or a reinforced top end section.

3.3 DROP INLET PROTECTION

Provide stakes evenly spaced around the perimeter of the drop inlet, a maximum of one meter apart. Stakes shall be driven immediately adjacent to the drainage structure, a minimum of 457 mm into the ground. The fabric shall be securely fastened to the outside of the stakes, with the bottom of the fabric placed into a trench and backfilled.

3.4 CONSTRUCTION ENTRANCE

Provide a minimum 15.2 meters long, 6.1 meters wide entrance, a minimum of 152 mm thick, at points of vehicular ingress and egress on the construction site. Construction entrances shall be cleared and grubbed, and then excavated a minimum of 76 mm prior to placement of the filter fabric and aggregate. The aggregate shall be placed in a manner that will prevent damage and movement of the fabric. Place fabric in one piece, where possible. Overlap fabric joints a minimum of 305 mm.

3.5 DUST SUPPRESSORS

Immediately dampen the surface before calcium chloride application. Apply dust suppressors on unsurfaced base, subbase and other unsurfaced travel ways. Apply calcium chloride at the rate of 4.9 to 6.1 kilograms per square meter of surface for pellets for the initial application. For subsequent applications of calcium chloride, application rates may be approximately 75 percent of initial application rates. Do not apply when raining or the moisture conditions exceed that required for proper application. Apply other dust suppressors in accordance with manufacturers instructions. Protect treated surfaces from traffic for a minimum of 2 hours after treatment. Repeat application of dust suppressors as required to control dust emissions.

3.6 TEMPORARY SEEDING

3.6.1 Time Restrictions

Within 48 hours after attaining the grading increment specified herein, provide seed, fertilizer, mulch and water on graded areas when any of the following conditions occur:

a. Grading operations stop for an anticipated duration of 30 days or more.

b. When it is impossible or impractical to bring an area to finish grade so that permanent seeding operations can be performed without serious disturbance from additional grading.

c. When an immediate cover is required to minimize erosion, or when erosion has occurred.

d. Provide on erosion control devices constructed using soil materials.

3.6.2 Seeding Requirements

3.6.2.1 State Standard Seeding Requirements

Provide seed, lime, and fertilizer in accordance with VSWCC VESCH Standard 3.31. Provide hay or straw mulch in an air dried condition, and secure mulch in place.

3.6.2.2 Permanent Seeding

Temporary seeding shall be removed, and permanent seeding shall be provided during the specified planting season in accordance with VSWCC VESCH Standard 3.32

3.7 EROSION CONTROL MATTING

Place matting in the direction of the flow of water. The up channel mat ting end shall be toed in a narrow trench a minimum of 127 mm deep. Where one roll of matting ends and a second roll begins, the end of the upper roll shall be brought over the buried end of the second roll, to provide a 152 mm overlap. Where matting widths are laid side by side, the overlap between matting shall be 102 mm. Provide check slots every 15 meters longitudinally in the matting. Construct check slots by providing a narrow trench 127 mm deep and folding the matting down in to the trench, across the bottom of the trench, and then back up the trench to the existing ground Backfill and compact the trench using the excavated material from the trench. Staple matting ends, junctions, and check slots at 254 mm on center. Staple matting outer edges and overlaps and the center of each matting strip at 1 meter on center. Install excelsior matting with the woven fabric on top.

3.8 MAINTENANCE AND INSPECTION

Inspect erosion control devices after each rainfall and daily during pro longed rainfall. Remove sediment deposits after each rainfall or when sediment reaches approximately one-half the barrier height. Immediately repair damaged erosion control devices and damaged areas around and underneath the devices. Maintain erosion control devices to assure continued performance of their intended function. Modify the erosion control plan as required to control problem areas noticed after each inspection. Modifications shall be approved by the Contracting Officer.

3.9 CLEAN UP

At the completion of the job, or when directed or approved by the Contracting Officer, temporary erosion control devices shall be removed. Erosion control devices and areas immediately adjacent to the device shall be filled (where applicable), shaped to drain and to blend into the surrounding contours, and provided with permanent seeding. Erosion control devices may remain in place after job completion when approved by the Contracting Officer.

-- End of Section --

D

SECTION 01575

TEMPORARY ENVIRONMENTAL CONTROLS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 258	Subtitle D Landfill Requirements
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standard for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 279	Used Oil Regulations
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 372-SUBPART D	EPA Toxic Chemical Release Reporting Regulations
49 CFR 173	Shipments and Packagings

1.2 DEFINITIONS

1.2.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material (except hazardous waste as defined in paragraph entitled "Hazardous Waste" or hazardous debris as defined in paragraph entitled "Hazardous Debris"), including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

c. Inert construction and demolition debris: Broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be re-inforced with or contain ferrous wire, rods, accessories and weldments.

d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.

e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as re-inforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.

g. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company.

1.2.3 Debris

Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 60 mm particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

1.2.4 Hazardous Debris

As defined in paragraph entitled "Debris" of this section, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.2.5 Chemical Wastes

This includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

1.2.6 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.7 Hazardous Waste

Hazardous waste as defined in 40 CFR 261 or as defined by applicable State and local regulations.

1.2.8 Oily Waste

Petroleum products and bituminous materials.

1.2.9 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)
chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)
chlorofluorocarbon-112 (CFC-112)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-212 (CFC-212)
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
halon-1211
halon-1301
halon-2402
carbon tetrachloride
methyl chloroform

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-08 Statements

a. Environmental protection plan G

1.3.2 SD-12 Field Test Reports

a. Laboratory analysis

1.3.2.1 Laboratory Analysis

Submit a copy of a laboratory analysis of solid waste and debris with the potential of becoming classified as a hazardous waste (i.e., abrasive/sand blasting debris, etc.). Waste stream determinations are required at the point of generation and must sufficiently document whether the waste will be a solid waste, hazardous waste, or Resource Conservation and Recovery Act (RCRA) exempt waste. Determinations must use EPA approved methods and provide written rational for whether the waste is classified as hazardous or non-hazardous. The Contractor shall bear the cost of the waste stream determinations, and the Contracting Officer reserves the right to request waste stream determinations on questionable waste streams.

1.3.3 SD-18 Records

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable subitems listed below.

a. Preconstruction survey

b. Solid waste disposal permit

c. Waste determination documentation

d. Disposal documentation for hazardous and regulated waste

e. Contractor 40 CFR employee training records

f. Regulatory notification

g. Solid waste disposal report

1.3.3.1 Preconstruction Survey

Perform a preconstruction survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.3.3.2 Solid Waste Disposal Permit

Submit one copy of a State and local permit or license showing such agencies' approval of the disposal plan before transporting wastes off Government property.

1.3.3.3 Waste Determination Documentation

The Contractor shall complete a Waste Determination form (provided at the pre-construction conference) for all contractor derived wastes to be generated. The waste determination must be based upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). All support documentation must be attached to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

1.3.3.4 Disposal Documentation for Hazardous and Regulated Waste

Submit a copy of the applicable EPA and State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities.

1.3.3.5 Contractor 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. Submit these training records to the Contracting Officer at the conclusion of the project, unless otherwise directed.

1.3.3.6 Regulatory Notification

The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. The Contractor shall forward copies to the Contracting Officer prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.3.3.7 Solid Waste Disposal Report

Monthly the Contractor shall submit a solid waste disposal report to the Contracting Officer. For each waste, the report shall state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste. The Contractor shall include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification shall include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor shall submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received shall not be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

1.4 CLASS I ODS PROHIBITION

Class I ODS as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall be considered to prevail over any other provision, specification, drawing, or referenced documents.

1.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

1.5.1 Licenses and Permits

Obtain licenses and permits pursuant to the "Permits and Responsibilities" FAR Clause.

1.5.2 Contractor Liabilities for Environmental Protection

The Contractor is advised that this project and the station are subject to Federal, State, and local regulatory agency inspections to review compliance with environmental laws and regulations. The Contractor shall fully cooperate with any representative from any Federal, State or local regulatory agency who may visit the job site and shall provide immediate notification to the Contracting Officer, who shall accompany them on any subsequent site inspections. The Contractor shall complete, maintain, and make available to the Contracting Officer, station, or regulatory agency personnel all documentation relating to environmental compliance under applicable Federal, State and local laws and regulations. The Contractor shall immediately notify the Contracting Officer if a Notice of Violation (NOV) is issued to the Contractor.

The Contractor shall be responsible for all damages to persons or property resulting from Contractor fault or negligence as well as for the payment of any civil fines or penalties which may be assessed by any Federal, State or local regulatory agency as a result of the Contractor's or any subcontractor's violation of any applicable Federal, State or local environmental law or regulation. Should a Notice of Violation (NOV), Notice of Noncompliance (NON), Notice of Deficiency (NOD), or similar regulatory agency notice be issued to the Government as facility owner/operator on account of the actions or inactions of the Contractor or one of its subcontractors in the performance of work under this contract, the Contractor shall fully cooperate with the Government in defending against regulatory assessment of any civil fines or penalties arising out of such actions or inactions.

1.6 ENVIRONMENTAL MANAGER

The Contractor shall appoint in writing an Environmental Manager for the project site. The Environmental Manager shall be directly responsible for coordinating contractor compliance with Federal, State, local, and station requirements. The Environmental Manager shall ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the Environmental Protection Plan; ensure that all environmental permits are obtained, maintained, and closed out; ensure compliance with Storm Water Program Management requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers). This can be a collateral position; however the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes to containers; ensure all Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out.

]1.7 ENVIRONMENTAL PROTECTION PLAN

Five days after the award of contract, the Contractor shall meet with the Contracting Officer to discuss the proposed Environmental Protection Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Environmental Protection Plan shall be submitted in the following format and shall, at a minimum, address the following elements (also refer to paragraph entitled "Protection of Natural Resources" in this section):

a. Description of the Environmental Protection Plan

(1) General overview and purpose

(2) General site information

(3) A letter signed by an officer of the firm appointing the Environmental Manager and stating that he/she is responsible for managing and implementing the Environmental Program as described in this contract. Include in this letter the Environmental Manager's authority to direct the removal and replacement of non-conforming work.

b. Protection of Natural Resources

(1) Land resources

(2) Replacement of damaged landscape features

(3) Temporary construction

(4) Fish and wildlife resources

c. Protection of Historical and Archaeological Resources

(1) Objectives

(2) Methods

d. Prevention of Releases to the Environment

(1) Procedures to prevent releases to the environment

(2) Notifications in the event of a release to the environment

e. Protection of the Environment from Waste Derived from Contractor Operations

(1) Control and disposal of solid and sanitary waste

(2) Control and disposal of hazardous waste (Hazardous Waste Management Section)

This item shall consist of the management procedures for all hazardous waste to be generated. The elements of those procedures shall coincide with the Activity Hazardous Waste Management Plan. A copy of the Activity Hazardous Waste Management Plan will be provided by the Contracting Officer. As a minimum, include the following:

(a) Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;

(b) Sampling/analysis plan;

(c) Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);

(d) Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);

(e) Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268);

(f) Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;

(g) Used oil management procedures in accordance with 40 CFR 279;

(h) Pollution prevention\hazardous waste minimization procedures;

(i) Plans for the disposal of hazardous waste by permitted facilities;

(j) Procedures to be employed to ensure all required employee training records are maintained.

1.7.1 Environmental Protection Plan Review

Fourteen days after the environmental protection meeting, submit the proposed Environmental Protection Plan for further discussion, review, and approval. Commencement of work shall not begin until the environmental protection plan has been approved.

1.8 UNFORESEEN HAZARDOUS OR REGULATED MATERIAL

All known hazardous or regulated materials are indicated in the contract documents. If material that is not indicated in the contract documents is encountered that may be dangerous to human health upon disturbance during construction operations, stop that portion of work and notify the Contracting Officer immediately. Intent is to identify materials such as PCB, lead paint, mercury, petroleum products, and friable and nonfriable asbestos. Within 14 calendar days the Government will determine if the material is hazardous. If the material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If the material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. Conform to the national permitting requirements of the Clean Water Act.

3.1.1 Land Resources

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor shall be responsible for any resultant damage.

3.1.2 Water Resources

3.1.2.1 Oily and Hazardous Substances

Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. For oil, fuel oil, or other hazardous substance spills, verbally notify the Contracting Officer immediately. Surround all temporary fuel oil or petroleum storage tanks with a temporary earth berm of sufficient size and strength to contain the contents of the tanks in the event of leakage or spillage.

]3.1.3 Fish and Wildlife Resources

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the Contracting Officer historical and archaeological items or human skeletal remains discovered in the course of work. Stop work in the immediate area of the discovery until directed by the Contracting Officer to resume work. The Government retains ownership and control over historical and archaeological resources.

3.3 CONTROL AND DISPOSAL OF SOLID WASTES

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the Contracting Officer and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Government property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

3.4 CONTROL AND DISPOSAL OF HAZARDOUS WASTES

3.4.1 Hazardous Waste/Debris Management

The Contractor shall identify all construction activities which will generate hazardous waste/debris. The Contractor must provide a documented waste determination for all resultant waste streams. Hazardous waste/debris shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268. Hazardous waste shall also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173. Hazardous waste generated within the confines of Government facilities shall be identified as being generated by the Government. Prior to removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by activity personnel from the Station Environmental Office. No hazardous waste shall be brought onto Government property. Provide to the Contracting Officer a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the Contracting Officer immediately.

3.4.1.1 Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor may request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the Contracting Officer providing the following information:

Contract Number	____________	Contractor	______________
Haz/Waste or Regulated Waste POC	____________	Phone Number	______________
Type of Waste	____________	Source of Waste	______________
Emergency POC	____________	Phone Number	______________

Location of the Site: ____________
(Attach Site Plan to the Request)

Attach a waste determination form. Allow ten working days for processing this request.

3.4.2 Pollution Prevention/Hazardous Waste Minimization

The Contractor shall actively pursue minimizing the use of hazardous materials and the generation of hazardous waste while on-base. The Hazardous Waste Management Section of the Environmental Protection Plan shall include the Contractor's procedures for pollution prevention/

hazardous waste minimization. For preparing this part of the plan, the Contractor may consult the activity Environmental Office for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material. If no written plan exists, the Contractor may obtain information by contacting the Contracting Officer. The Contractor shall describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.4.3 Hazardous Material Control

The Contractor shall include hazardous material control procedures in the Safety Plan. The procedures shall address and ensure the proper handling of hazardous materials, including the appropriate transportation requirements. The Contractor shall submit a MSDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the project, the Contractor shall provide the Contracting Officer with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used. The Contractor shall also ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. The Contractor shall ensure that all containers of hazardous materials have NFPA labels or their equivalent. Copies of the MSDS for hazardous materials shall be kept on site at all times and provided to the Contracting Officer at the end of the project. The Contractor shall certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.4.4 Petroleum Products

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. All used oil generated on site shall be managed in accordance with 40 CFR 279. The Contractor shall determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. In addition, used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste. All hazardous waste will be managed in accordance with the paragraph entitled Hazardous Waste/Debris Management of this section and shall be managed in accordance with the approved Environmental Protection Plan.

3.4.5 Spills of Oil and Hazardous Materials

Take precautions to prevent spills of oil and hazardous material. In the event of a spill, immediately notify the Contracting Officer. Spill response shall be in accordance with 40 CFR 300 and applicable State regulations.

3.5 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.6 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the Contracting Officer, and then only during the designated times.

-- End of Section --

SECTION 01580

PROJECT IDENTIFICATION
06/97

PART 1 GENERAL

1.1 PROJECT SIGN

Within 15 days after the commencement of work, provide one project identification sign at the location designated. Construct the sign in accordance with project sign detail attached at the end of this section. Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site.

1.2 Project Identification Signboard (Navy)

A project identification signboard shall be provided in accordance with attached Plate 1. The signboard shall be provided at a conspicuous location on the job site where directed by the Contracting Officer. Construct signboard in accordance with project identification signboard Plates 3 and 4.

a. The field of the sign shall consist of a 1200 by 2400 mm sheet of grade B-B medium density overlaid exterior plywood.

b. Lumber shall be B or Better Southern pine, pressure-preservative treated with pentachlorophenol. Nails shall be aluminum or galvanized steel.

c. The entire signboard and supports shall be given one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint. The lettering and sign work shall be performed by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles shall be as indicated. Where preservative-treated lumber is required, utilize only cured pressure-treated wood which has had the chemicals leached from the surface of the wood prior to painting.

d. The high gloss acrylic gold enamel paint used as background for the Department of the Navy - Atlantic Division, Naval Facilities Engineering Command applied sticker shall be spray applied automotive quality paint. The 450 mm diameter applied sticker shall be a silkscreened image in the design indicated, painted on a 2 millimeter transparent polyester film. The weather resistant, self adhering film shall be rated for a minimum of 2 year exterior vertical exposure and be mounted to sign with pressure sensitive, permanent acrylic adhesive. Shop cut sticker to round shape and provide pull-off backing sheet on adhesive side of design sticker for shipping. Provide applied design sticker in accordance with attached detail.

e. Sign paint colors (numbers listed below for color identification only)

    (1) Blue = Benjamin Moore Paints No. 826.

    (2) White = Benjamin Moore Paints No. 873.

(3) Gold = Dupont No. B8014, Metallic gold.

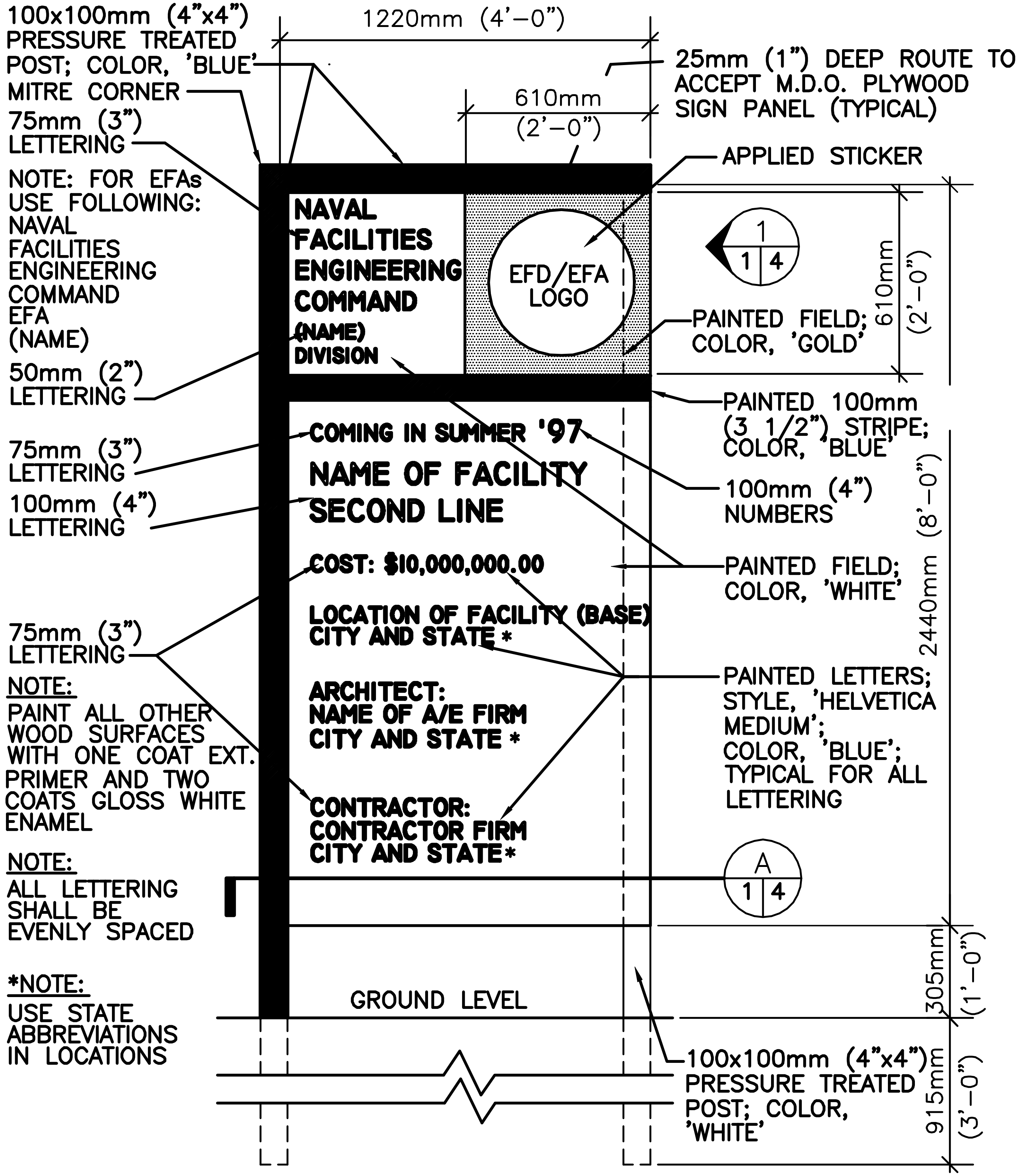
PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --



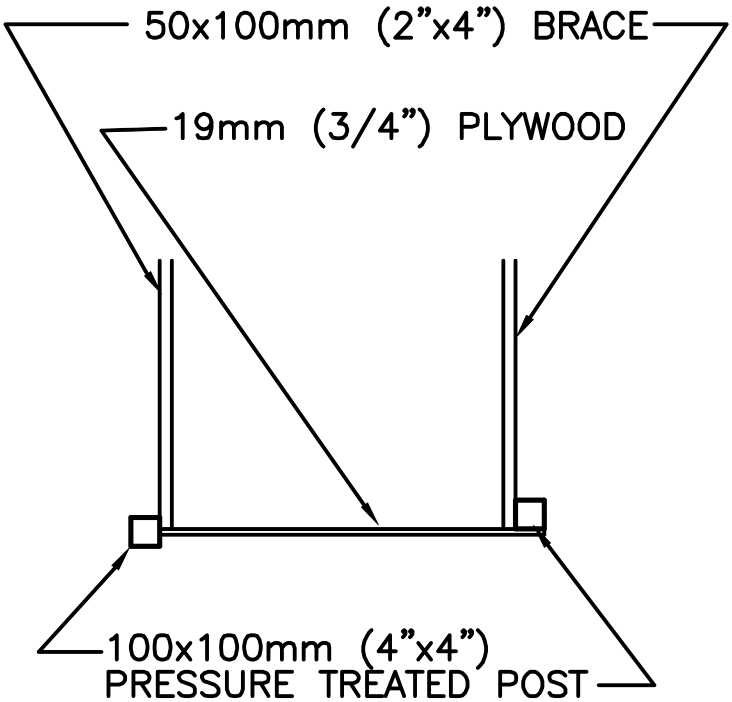
PROJECT IDENTIFICATION SIGNBOARD WITHOUT RENDERING

SCALE: NONE

PLATE 1 OF 7

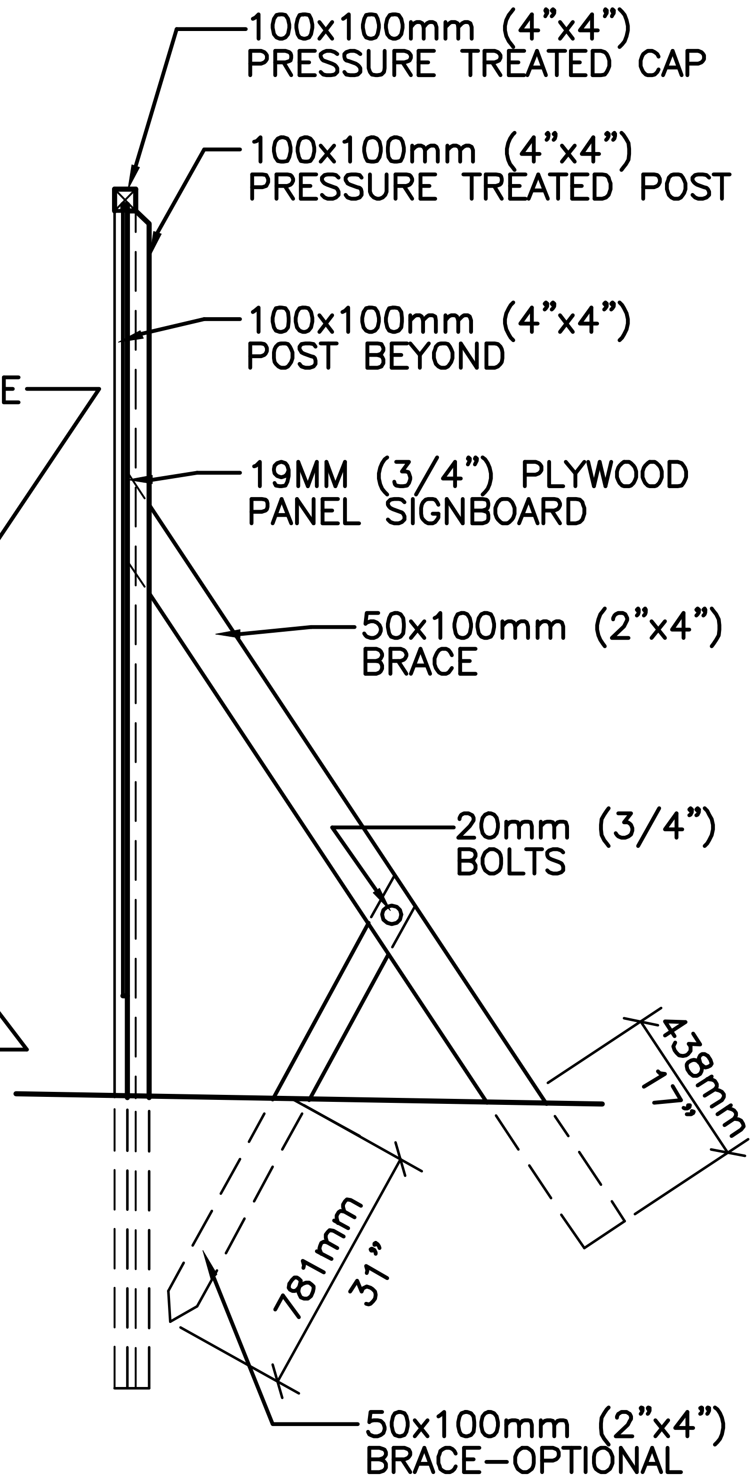
NOTE:
POSTS AND BRACES SHALL BE PRESSURE TREATED.
ALL FASTENINGS SHALL BE ZINC COATED.

INCLUDE OPTIONAL BRACING IN UNSTABLE SOIL OR HIGH WIND ENVIRONMENTS.



A
1,2 | 4

TOP VIEW
SCALE: 3"=1'-0"



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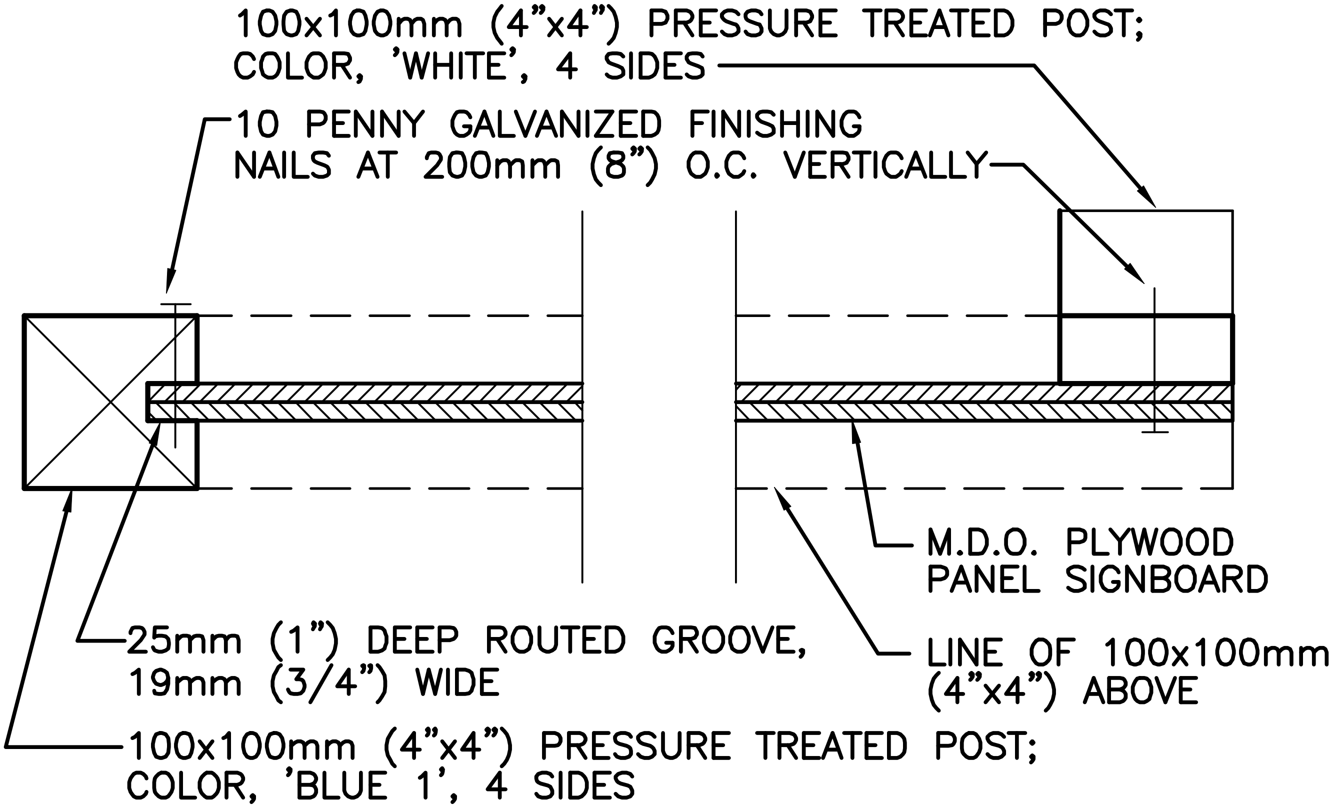
1,2 | 4

SIDE VIEW

PROJECT IDENTIFICATION SIGNBOARD

SCALE: NONE **SUPPORT DETAILS** PLATE 3 OF 7



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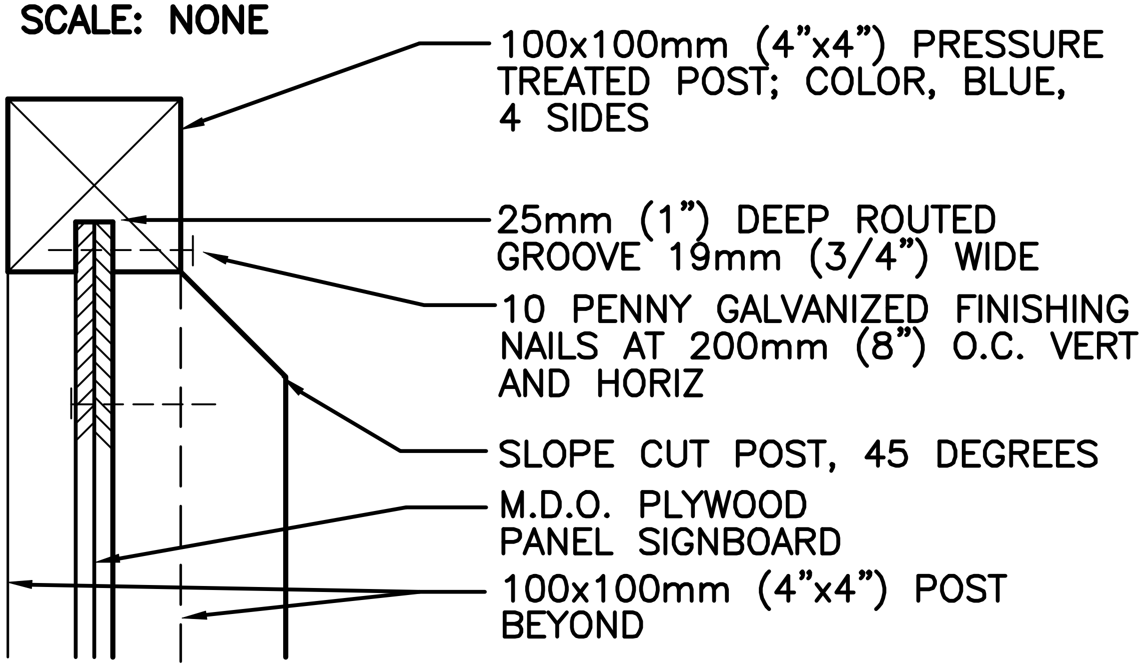
1,2 4

PLAN SECTION

SCALE: NONE



1
1,2 4

DETAIL AT END

SCALE: NONE

PROJECT IDENTIFICATION SIGNBOARD SECTIONS

PLATE 4 OF 7

UNITED STATES NAVY

NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION

APPLIED STICKER DETAIL

PROJECT IDENTIFICATION SIGNBOARD

NOT TO SCALE

SECTION 01770

CLOSEOUT PROCEDURES
03/97

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.1.1 SD-18, Records

a. As-built drawings G

b. Record of materials G

c. Equipment/product warranty tag G

1.1.2 SD-19, Operation and Maintenance Manuals

a. Equipment/product warranty list

Submit Data Package 1 in accordance with Section 01781, "Operation and Maintenance Data."

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

"FAC 5252.236-9310, Record Drawings." In addition to the requirements of FAC 5252.236-9310, the Contractor shall survey the horizontal and vertical location of all utilities to within 30 mm relative to the station datum. All pipe utilities shall be surveyed at each fitting and every 10 m of run length. Electrical and communication ductbank, direct buried conduit, and direct buried conductor shall be surveyed every 10 m and at each change of direction. Locations and elevations shall be recorded on the Record Drawings. Submit drawings with QC certification.

1.2.2 As-Built Record of Materials

Furnish a record of materials.

Where several manufacturers' brands, types, or classes of the item listed have been used in the project, designate specific areas where each item was used. Designations shall be keyed to the areas and spaces depicted on the contract drawing. Furnish the record of materials used in the following format:

MATERIALS DESIGNATION	SPECIFICATION	MANUFACTURER	MATERIALS USED (MANUFACTURER'S DESIGNATION)	WHERE USED

1.3 EQUIPMENT/PRODUCT WARRANTIES

1.3.1 Equipment/Product Warranty List

Furnish to the Contracting Officer a bound and indexed notebook containing written warranties for equipment/products furnished under the contract, and prepare a complete listing of such equipment/products. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefor, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period. Execute the full list and deliver to the Contracting Officer prior to final acceptance of the facility.

1.3.2 Equipment Warranty Tags and Guarantor's Local Representative

Furnish with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed. The guarantor's representative, upon request of the station representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Contracting Officer. Attach tag with copper wire and spray with a clear silicone waterproof coating. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy. Tag shall show the following information:

EQUIPMENT/PRODUCT WARRANTY TAG

Type of Equipment/Product ____________________
Warranty Period __________ From __________ To __________
Contract No. ____________________
Inspector's Signature _____________________ Date Accepted ____________

Construction Contractor:
Name: ____________________
Address: _______________________
Telephone: _______________________

Warranty Contact: __________________
Name: ____________________
Address: ________________________
Telephone: ________________________

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

1.4 CLEANUP

Leave premises "broom clean." Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment. Clean debris from drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

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SECTION 01781

OPERATION AND MAINTENANCE DATA
09/96

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data/Manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and section titled "Submittal Procedures."

1.1.1 Quantity

Submit three sets of the supplier/manufacturers' O&M information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The items for which O&M Data/Manuals are required are listed in the technical sections which specifies those particular items.

1.1.2 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.3 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." For each product, system, or component piece of equipment requiring submission of O&M Data, submit the Data Package specified in the individual technical section.

1.1.4 Delivery

Submit O&M Data Manuals to the Contracting Officer for review and acceptance; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

a. In the event the Contractor fails to deliver O&M Data/Manuals within the time limits set forth above, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data/Manuals are associated.

1.1.5 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Prestart

Include procedures required to set up and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Postshutdown Procedures

Provide narrative description for each operating procedure including control sequence for each.

1.2.1.4 Normal Operations

Provide narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and gage reading recording.

1.2.1.7 Environmental Conditions

Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.2.2.1 Lubrication Data

Include lubrication data, other than instructions for lubrication in accordance with paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications;

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and

c. A lubrication schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.6 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies. Parts data may cover more than one model or series of equipment. components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

1.2.6.1 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.6.2 Personnel Training Requirements

Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.2.6.3 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.6.4 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M Data Packages specified in individual technical sections. The required information for each O&M Data Package is as follows:

1.3.1 Data Package 1

a. Safety precautions

b. Maintenance and repair procedures

c. Warranty information

d. Contractor information

e. Parts list (for assembled items)

1.3.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Maintenance and repair procedures

g. Removal and replacement instructions

h. Spare parts and supply list

i. Parts identification

j. Warranty information

k. Contractor information

1.3.3 Data Package 3

a. Safety precautions

b. Normal operations

c. Emergency operations

d. Environmental conditions

e. Lubrication data

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring diagrams and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Parts identification

m. Warranty information

n. Testing equipment and special tool information

o. Contractor information

1.3.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and postshutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Corrective maintenance man-hours

p. Parts identification

q. Warranty information

r. Personnel training requirements

s. Testing equipment and special tool information

t. Contractor information

1.3.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Spare parts and supply list

k. Testing equipments and special tools

l. Warranty information

m. Contractor information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

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SECTION 02001

DIVISION 02 SUBMITTAL REDUCTION PROCEDURES
06/98

PART 1 GENERAL

1.1 SUBMITTALS

1.1.1 SUBMITTAL REDUCTION

Specification sections listed in this section have manufacturers' products that may be selected for submittal reduction. If listed manufacturer's products are selected, the Government will waive the submittal requirements specified in the applicable specification sections, except for SD-06 Instructions, SD-19 Operation and Maintenance Manuals, and other noted exceptions. These other noted exceptions will be indicated with the section title and the manufacturer's product in Part 2 of this specification section.

1.1.2 Unused Submittal Reduction

The contractor may use other non-listed products. If the contractor chooses to use a product which complies with the requirements of the specification but is not listed for submittal reduction, the contractor shall provide all submittals required in the specification section in accordance with Section 01330, "Submittal Procedures".

1.2 SUBMITTAL REDUCTION REQUIREMENT

Submittals for each specification section in Division 02, which list manufacturer's name and model numbers in this section may be reduced by providing a letter stating which one of the listed manufacturers will be utilized on the project. To accomplish this, provide an original letter on official stationary with a signature by a principal of the company, referencing this project by name, contract number, specification number, specification section, manufacturer's name and model number. The letter must have the QC Manager stamp of approval.

1.3 PRECEDENCE

The use of this specification section allows alterations to the normal submittal procedures, however, these modifications do not eliminate other unaffected requirements of Section 01330, "Submittal Procedures". Submittal procedures of this specification section take precedence over the procedures noted in Section 01330, "Submittal Procedures". Procedures specified in Section 01330 which are not affected by this specification section remain in effect.

PART 2 PRODUCTS

2.1 SECTION 02510, "WATER DISTRIBUTION"

2.1.1 Gate Valves (100mm and larger)

2.1.1.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.
a. American AVK Co. 5519 E. Hedges Fresno, CA 93727 Phone (209) 251-8862	Series 25 Resilient seated gate valve
b. Mueller Co. 500 West Eldorado Street P.O. Box 671 Decatur, IL 62525 Phone (217) 423-4471	Series A2360 (buried piping) Series R2361 (above ground) Resilient seated gate valve
c. Clow Valve Co. 902 S. Second Street Oskaloosa, IO 52577 Phone (515) 673-8611	F6000 Series Resilient Wedge Gate Valve

2.1.2 Backflow Preventers (200mm and smaller)

2.1.2.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.
a. CMB Industries P.O. Box 8070 Fresno, CA 93747 Phone (559) 252-0791	Model 860 FEBCO Reduced Pressure Backflow Preventer
b. CLA-VAL Co. P.O. Box 1325 Newport Beach, VA 92659 Phone (714)722-4800	RP8L Reduce Pressure Backflow Preventer
c. Watts Regulator Co. 815 Chestnut Street North Andover, MA 01845 Phone (978)688-1811	Series 909 Reduce Pressure Backflow Preventer

2.1.3 Freeze Protection Valve

2.1.3.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.

a. Ogontz Corporation 2835 Terwood Road Willow Grove, PA 19090 Phone (800) 523-2478	Type F Freeze Protection Valve
b. Therm-Omega-Tech, Inc. 207 Witmer Road Horsham, PA 19044 Phone (800) 288-4878	IC/FP-T Freeze Protection Valve

2.1.4 Water Meter

2.1.4.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.
a. Sensus Technologies, Inc P.O. Box 487 450 N. Gallatin Ave Uniontown, PA 15401 Phone (800) 638-3748	Model W-2000DR Turbo-Meter
b. Badger Meter, Inc P.O. Box 23099 4545 W. Brown Deer Road Milwaukee, WI 53223 Phone (800) 876-3837	Recordall Turbo Meter
c. Master Meter, Inc. 1001 McKesson Drive Longview, TX 75604 Phone (800) 765-6518	MMT Cold Water Turbine Meter

2.1.5 Fire Hydrant (Dry-Barrel)

2.1.5.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.
a. American AVK Co. 5519 E. Hedges Fresno, CA 93727 Phone(209)251-8862	Model 2780 Fire Hydrant, 4-1/2 inch pumper connection 2 2-1/2 inch hose connection
b. Mueller Co. 500 West Eldorado Street P.O. Box 671 Decatur, IL 62525 Phone (217) 423-4471	Model A-436 Super Centurion 250(tm) fire hydrant AWWA Type, three way

c. American Cast Iron Pipe Co.	American Flow Control's American Darling Model B-84-B

2.2 SECTION 02530, "SANITARY SEWERAGE"

2.2.1 Frames, Covers, and Grating for Manholes for Solid Circular Covers

2.2.1.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.
a. Neenah Foundry P.O. Box 729 Neenah, WI 54957 Phone (920) 725-7000	Traffic MH, Model No. 1670 Nontraffic MH, Model 1792-FL

2.3 SECTION 02630, "STORM DRAINAGE"

2.3.1 Frames, Covers, and Grating

2.3.1.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

Manufacturer's Name	Manufacturer's Model No.
a. Neenah Foundry P.O. Box 729 Neenah, Wi 54957 Phone (920) 725-7000	For Solid Circular Covers/Frames: Traffic MH, Model No. 1670 Non-traffic MH, Model 1792-FL For Grate Circular Covers/Frames: Traffic Catch Basin, Model No. 1670 with grate Non-traffic Catch Basin, Model 1792-FG

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 02220

SITE DEMOLITION
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	(1990) Demolition Operations

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K	(1990) Containers for Recovered Fluorocarbon Refrigerants

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 82	Protection of Stratospheric Ozone; Refrigerant Recycling
49 CFR 173.301	Shipment of Compressed Gas Cylinders

DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	Storage and Handling of Compressed Gases and Liquids in Cylinders

DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	Requisitioning and Issue Procedures

MILITARY STANDARDS (MIL-STD)

MIL-STD-129	(Rev. M) Marking for Shipment and Storage

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. Store materials that cannot be removed daily in areas specified by the Contracting Officer. Demolish and remove materials containing asbestos in accordance with Section 13281, "Engineering Control of Asbestos Containing Materials." Section 01575, "Temporary Environmental Controls."

1.3 DEFINITIONS

1.3.1 Class I and Class II Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act.

1.4 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.4.1 SD-08, Statements

a. Demolition plan

1.4.1.1 Required Data

Demolition plan shall include procedures for coordination with other work in progress, a disconnection schedule of utility services and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work.

1.4.2 SD-18, Records

a. Receipts

1.4.2.1 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

1.6 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to areas still in operation. Avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris.

1.7 PROTECTION

1.7.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.7.2 Existing Work

Protect existing work which is to remain in place. Do not overload pavements to remain.

1.7.3 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.8 BURNING

Burning will not be permitted.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Buildings Z-86 and Z-357

Buildings Z-86 and Z-357 are to be demolished as indicated. Both buildings are known to contain hazardous materials. For additional requirements refer to Section 13281, "Engineering Control of Asbestos Containing Materials," Section 13282, "Removal and Disposal of Painted Building Surfaces Containing Lead," Section 13286, "Handling of Lighting Ballasts and Lamps Containg PCB's and Mercury" and the Environmental Report included with these sections.

3.1.2 Structures

Remove indicated existing structures as indicated.

3.1.3 Utilities and Related Equipment

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. Remove meters and related equipment and deliver to a location on the station in accordance with instructions of the Contracting Officer. If utility lines are encountered that are not shown on drawings, contact the Contracting Officer for further instructions.

3.1.4 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated. Provide neat sawcuts at limits of pavement removal as indicated.

3.1.5 Air Conditioning Equipment

Remove air conditioning equipment without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990.

Recover all refrigerants prior to removing air conditioning equipment and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

3.1.6 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.2 FILLING

Fill holes, open basements, and other hazardous openings [in accordance with Section 02315, "Excavation and Fill."

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.3.2 Disposal of Ozone Depleting Substance (ODS)

Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and dispose of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.2.1 Special Instructions

Each container shall have in it no more than one type of ODS. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

e. Naval stock number (for information, call (804) 279-4525).

3.3.2.2 Fire Suppression Containers

Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.3 Transportation Guidance

Shipment of all ODS containers shall be in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.4 CLEANUP

3.4.1 Debris and Rubbish

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Limit to 1/4 cubic meter capacity buggies or other conveyances used on roofs and within the building to transport removed debris to chute locations. Clean up spillage from pavements, streets and adjacent areas.

-- End of Section --

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SECTION 02272

GEOTEXTILE FABRIC

11/98

PART 1 GENERAL

This section covers geotextile fabrics to be used under paved and gravel roads.

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphram Bursting Strength Tester Method
ASTM D 4354	(1996) Sampling of Geosynthetics for Testing
ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1996) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(1988; R 1996) Determining the Specification Conformance of Geosynthetics
ASTM D 4873	(1995) Identification, Storage, and Handling of Geosynthetic Roles

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Fabric Literature G

1.2.1.1 Fabric Literature

Submit descriptive literature, specifications, performance test data, instructions, and installation recommendations for the fabric.

1.2.2 SD-04 Drawings

a. Engineered penetrations G

1.2.3 SD-06 Instructions

a. Manufacturing, Sampling, and Testing

A minimum of 14 days prior to scheduled use, Manufacturer's quality control manual including instructions for storage, handling, installation, seaming, and repair.

1.2.4 SD-13 Certificates

a. Geotextile G

A minimum of 14 days prior to scheduled use, Manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. This submittal shall include copies of manufacturer's quality control test results. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturing company.

1.2.5 SD-14 Samples

a. Geotextile G

A minimum of 14 days prior to scheduled use, one sample shall be provided for testing. The sample shall be the full manufactured width of the geotextile and a minimum of 1.5 meters in length, folded over and the edges stitched with the same thread type, stitch density, and machine that will be used during construction. A smaller sample will be approved when no testing of the samples will be performed by the Government.

1.3 DELIVERY, STORAGE AND HANDLING

1.3.1 General

Geotextiles shall be labeled, handled, and stored in accordance with ASTM D 4873 and as specified herein. Each roll shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrapping shall not be removed until deployment. Each roll shall be labeled with the manufacturers name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight). Geotextile or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed. Geotextile shall not be exposed to temperatures in excess of 60 degrees C or less if recommended by the manufacturer.

1.3.2 Handling

No hooks, tongs or other sharp instruments shall be used for handling geotextile. Geotextile shall not be dragged along the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

The geotextile shall be a woven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material which consists of edge trimming and other scraps that have never reached the consumer may be used to produce the geotextile. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages. The geotextile physical properties shall equal or exceed the minimum average roll values listed in Table 1. Acceptance of geotextile shall be in accordance with ASTM D 4759. Strength values shown are for the weaker principal direction.

TABLE 1 - GEOTEXTILE PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE
Apparent Opening Size (U.S. Sieve)	ASTM D 4751	40
Permittivity, sec-1	ASTM D 4491	0.02
Puncture, N	ASTM D 4833	530
Grab Tensile, N	ASTM D 4632	1330
Trapezoidal Tear, N	ASTM D 4533	530
Burst Strength, kPa	ASTM D 3786	4100
Ultraviolet Degradation (percent strength retained at 500 hours)	ASTM D 4355	70
Seam Strength, N	ASTM D 4632	1060

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.1 Manufacturing, Sampling, and Testing

Geotextiles and factory seams shall meet the requirements specified in Table 1. Manufacturing quality control testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354 (Procedure A).

2.2.2 Certified Site Verification Sampling and Testing

Samples shall be collected upon delivery to the site in two separate locations at the request of the Contracting Officer. Samples shall be tested to verify the geotextile meets the requirements specified in Table 1. ASTM D 4355 does not need to be performed on the collected samples.

Samples shall be identified by manufacturer's name, type of geotextile, lot number, roll number, and machine direction. Testing shall be performed at an approved laboratory. Test results from the lot under review shall be submitted and approved prior to deployment of that lot of geotextile. Rolls which are sampled shall be immediately rewrapped in their protective covering.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 02315, "Excavation and Fill."

3.2 INSTALLATION

The Contracting Officer shall be present during handling and installation. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. Place geotextile smooth so as to be free of tensile stresses, folds, and wrinkles. Extend fabric to the edges of the stone base. Overlap fabric at joints a minimum of 1 meter. At tranverse joints, tuck the following roll under the previously placed fabric. Do not place more fabric then can be covered with the base course material that same working day. Repair damaged fabric by placing an additional layer over the damaged area, overlapping .33 meter in all directions.

3.3 ENGINEERED PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by approved methods recommended by the geotextile manufacturer.

-- End of Section --

SECTION 02315

EXCAVATION AND FILL
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 136	(1995; Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	(1992) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 2321	(1989) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1992) Safety and Health Requirements Manual

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(1994) Road and Bridge Specifications

1.2 DEFINITIONS

1.2.1 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 0.375 cubic meter in volume Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.3 Cohesive Materials

Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials

Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 1 ppm of the sum of benzene, toluene, ethyl benzene, and xylene (BTEX). Provide Borrow Site Testing for TPH and BTEX from composite sample of material from borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal

Procedures."

1.4.1 SD-09, Reports

a. Borrow Site Testing

1.4.2 SD-12, Field Test Reports

a. Fill and backfill test

b. Select material test

c. Density tests

1.5 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Material character is indicated by the boring logs.

e. Blasting will not be permitted. Remove material in an approved manner.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, 75 micrometers sieve.

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 25 mm diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.1.4 Select Material

ASTM D 2487, classification GW, GP, SW, SP.

2.2 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.3 GRAVEL FOR ELECTRICAL SUBSTATION

Provide clean crushed stone, crushed gravel, or uncrushed gravel conforming to ASTM C 33 coarse aggregate grading size 57 or stone conforming to VDOT RBS size No. 5. Underlay stone or gravel with geotextile fabric material as specified in Section 02272, "Geotextile Fabric Material".

2.4 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems

2.4.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.08 mm . Tape shall have a minimum strength of 10.3 MPa lengthwise, and 8.6 MPa crosswise, with a maximum 350 percent elongation.

2.4.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.10 mm . Tape shall have a minimum strength of 10.3 MPa lengthwise and 8.6 MPa crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.5 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Stripping

Strip existing topsoil to a depth of 100 mm without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.1.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.1.2.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping or pavement removal, proof roll the existing subgrade with six passes of a dump truck loaded with 6 cubic meters of soil in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 kilometers per hour . Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer and replace with select material.

3.2 PROTECTION

3.2.1 Protection Systems

Provide shoring, bracing and sheeting in accordance with COE EM-385-1-1.

3.2.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.2.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 1 m below the working level.

3.2.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.2.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with select material and compact to 95 percent of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 95 percent of ASTM D 698 maximum density.

3.3.1 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Common Fill Placement

Provide for general site. Place in 150 mm lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.4.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 150 mm lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.3 Select Material Placement

Provide as indicated. Place in 150 mm lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.4.4 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under paved areas in 150 mm lifts to top of trench.

3.4.4.1 Bedding Requirements

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 6 to 40 mm , graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 40 mm , including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.4.5 Gravel Placement

Place gravel where indicated on drawings. Place material on geotextile fabric material over compacted subgrade.

3.5 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 300 mm below finished grade; under pavements and slabs, bury tape 150 mm below top of subgrade.

3.6 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.7 COMPACTION

Expressed as a percentage of maximum density. Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required.

3.7.1 General Site

Compact underneath areas designated for vegetation and areas outside the 1.5 meter line of the structure to 85 percent of ASTM D 698.

3.7.2 Paved Areas

Compact top 300 mm of subgrades to 95 percent of ASTM D 698. Compact fill and backfill materials to 95 percent of ASTM D 698.

3.7.3 Gravel

Compact gravel in lifts of 100 mm with a minimum of two passes of a hand-operated plate type vibratory compactor per lift.

3.8 FINISH OPERATIONS

3.8.1 Grading

Finish grades as indicated within 30 mm . Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.8.2 Seed

Provide as specified in Section 01561, "Erosion and Sediment Control."

3.8.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.9 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property] surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.10 FIELD QUALITY CONTROL

3.10.1 Sampling

Take the number and size of samples required to perform the following tests.

3.10.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.10.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the 75 micrometers sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the 75 micrometers sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.3 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 200 square meters of existing grade in fills for structures and concrete slabs, and every 250 square meters for other fill areas and every 200 square meters of subgrade in cut.

-- End of Section --

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SECTION 02325

DREDGING
09/97

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.1.1 SD-04, Drawings

a. Submerged pipeline

b. Soundings or sweepings G

Indicate pipeline location and installation details. Submit drawings of surveys during progress of work by soundings or sweepings.

1.2 MATERIAL TO BE REMOVED

Characteristics of the material to be removed is as outlined in the boring logs included on the drawings.

1.3 ARTIFICIAL OBSTRUCTIONS

The Government has knowledge of existing debris as indicated on the Contract drawings. Prior to dredging, the Contractor shall rake the dredge areas and shall remove debris encountered. Debris removed from the dredged area shall be removed from the water. Disposal shall be the responsibility of the Contractor and disposal shall be outside the limits of government property. In case the actual conditions differ from those stated or shown, or both, an adjustment in contract price or time of completion, or both, will be made in accordance with "FAR 52.236-2, Differing Site Conditions."

1.4 QUANTITY OF MATERIAL

The total estimated amount of material to be removed from within the specified limits, including side slopes, but excluding overdepths, is 1,048,650 cubic meters . The maximum amount of allowable overdepth dredging is estimated to be 201,350 cubic meters . The estimated quantity for bidding purposes and for application of the "FAR 52.212-11, Variation in Estimated Quantity" shall be 1,250,000 cubic meters , which is the total quantity, including overdepth. The quantities listed are estimates only. Within the limits of available funds, complete the work specified whether the quantities involved are greater or less than those estimated.

1.5 OVERDEPTH DREDGING

To cover unavoidable inaccuracies of dredging processes, material actually removed to a depth of .61 meters below the depth specified and within the dredging limits will be measured and paid for at full contract price.

1.6 SIDE SLOPES

Dredging on side slopes shall follow, as closely as practicable, the lines indicated or specified. An allowance will be made for dredging beyond the lines indicated or specified for side slopes. The allowance will be determined by projecting a line upwards, paralleling the project design side slopes, from the intersection of the overdepth dredging limit (at a point located vertically below the limit of dredging at the top of slope). The amount of material excavated from side slopes will be determined by either cross-sections or computer, or both.

1.7 PERMIT

The Contractor shall comply with conditions and requirements of the Corps of Engineers Permit and other State or Federal permits. The Contracting Officer will secure the permit for dredging and disposal of material as indicated. Make arrangements with the Army for disposal of excavated materials. A copy of the permit is obtainable from LANTDIV Code 405, contact: Paul Steele at (757)-322-4288.

1.8 CHARGES

The Government will pay charges imposed by the Department of the Army for disposal of material in the Craney Island disposal area.

1.9 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain during the life of the contract, environmental protective measures. Also, provide environmental protective measures required to correct conditions, such as oil spills or debris, that occur during the dredging operations. Comply with Federal, State, and local regulations pertaining to water, air, and noise pollution.

1.10 BASIS FOR BIDS

Payment will be at the contract unit price per cubic meter, multiplied by total cubic meters of acceptable dredging. Base bids on total cubic meters of dredging, as specified in Section 00120, "Supplementary Instructions to Bidders." Include a bid unit price per cubic meter of dredging based on the quantity stated in Section 00120, "Supplementary Instructions to Bidders." If the Contracting Officer requires an increase or a decrease in total volume of dredging, the contract price will be adjusted in accordance with the "FAR 52.211-18, Variation in Estimated Quantity." Dredging conditions specified and indicated describe conditions which are known. However, the Contractor is responsible for other conditions encountered which are not unusual when compared to conditions recognized in the dredging business as usual in dredging activities such as those required under this contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 INSPECTION

The Government will keep a record of work performed and will require that gages, ranges, and other markers are usable for the intended purpose. Furnish, at the request of the Contracting Officer, boats, boatmen, laborers, and materials necessary for inspecting, supervising, and surveying the work. When required, provide transportation for the

Contracting Officer and inspectors to and from the disposal area and between the dredging plant and adjacent points on shore.

3.2 CONDUCT OF DREDGING WORK

3.2.1 Order of Work

The Contracting Officer will direct the Contractor on the order of work. The Government reserves the right to change the order of work at any time.

3.2.2 Interference with Navigation

Minimize interference with the use of channels and passages. The Contracting Officer will direct the shifting or moving of dredges or the interruption of dredging operations to accommodate the movement of vessels and floating equipment, if necessary.

3.2.2.1 Compensation for Interruption of Operations

If dredging operations are interrupted due to the movement of vessels or floating equipment, an adjustment in the contract price or time for completion, or both, will be made as provided by the contract. The Contracting Officer will notify the Contractor 7 days prior to ship movements that will affect dredging operations.

3.2.3 Lights

Each night, between sunset and sunrise and during periods of restricted visibility, provide lights for floating plants, pipelines, ranges, and markers. Also, provide lights for buoys that could endanger or obstruct navigation. When night work is in progress, maintain lights from sunset to sunrise for the observation of dredging operations. Lighting shall conform to United States Coast Guard requirements for visibility and color.

3.2.4 Ranges, Gages, and Lines

Furnish, set, and maintain ranges, buoys, and markers needed to define the work and to facilitate inspection. Establish and maintain gages in locations observable from each part of the work so that the depth may be determined. Suspend dredging when the gages or ranges cannot be seen or followed. The Contracting Officer will furnish, upon request by the Contractor, survey lines, points, and elevations necessary for the setting of ranges, gages, and buoys.

3.2.5 Plant

Maintain the plant, scows, coamings, barges, pipelines, and associated equipment to meet the requirements of the work. Promptly repair leaks or breaks along pipelines. Remove dredged material placed due to leaks and breaks.

3.2.6 Disposal of Excavated Material

Provide for safe transportation and disposal of dredged materials. Transport and dispose of dredged material in the Craney Island Disposal Area. Place pipeline along the South Division Road for disposal in the Southern or Center Cell, as directed by the Army. The deposit of dredged materials in unauthorized places is forbidden. Comply with rules and regulations of local port and harbor governing authorities.

3.2.6.1 Method of Disposal

Deposit dredged material by the hydraulic process. Pipeline for hydraulic dredging shall discharge into the disposal area.

3.2.6.2 Disposal in Indicated Fill Areas

In depositing excavated material for fill, uniformly grade and allow for shrinkage. Provide and maintain necessary bulkheads, dikes, ditches, weirs, spillways, and other construction necessary to confine and retain the fill in the dredge fill area.

3.2.6.3 Operation of Sluiceways

Sluiceways on the disposal area levees will be operated and maintained by the Army Corps of Engineers. The Contractor will be relieved of operations thereof.

3.2.6.4 Submerged Pipeline

If a leak occurs in the discharge pipeline, immediately discontinue using the line until leaks are repaired. Remove material placed due to leaks or breaks.

3.2.7 Navigation Warnings

Furnish and maintain navigation warning signs along the pipeline.

3.2.8 Method of Communication

Provide a system of communication between the dredge crew and the crew at the disposal area. A portable two-way radio is acceptable.

3.2.9 Salvaged Material

Anchors, chains, firearms, and other articles of value, which are brought to the surface during dredging operations, shall remain or become the property of the Government and shall be deposited on shore at a convenient location near the site of the work, as directed.

3.2.10 Safety of Structures

The prosecution of work shall ensure the stability of piers, bulkheads, and other structures lying on or adjacent to the site of the work, insofar as structures may be jeopardized by dredging operations. Repair damage resulting from dredging operations, insofar as such damage may be caused by variation in locations or depth of dredging, or both, from that indicated or permitted under the contract.

3.2.11 Plant Removal

Upon completion of the work, promptly remove plant, including ranges, buoys, piles, and other markers or obstructions.

3.3 MEASUREMENT

Government will take soundings before and after dredging.

3.3.1 Method of Measurement

The material removed will be measured by cubic meter in place, by means of soundings taken before and after dredging. The drawings represent existing conditions based on current available information, but will be verified and corrected, if necessary, by soundings taken before dredging in each locality. Soundings will be taken by lead line or 200 kHz sonic methods, or both, as determined by the Government; results of soundings by either or both methods will be the basis for payment. Areas sounded more than 30 days prior to dredging will be re-sounded when requested by the Contractor. The Contractor has the option of being present when such soundings are made.

3.3.2 Surveys During Progress of Work

Contract depth will be determined by soundings or sweepings taken behind the dredge as work progresses. The Contractor shall take progress soundings or sweepings.

3.3.3 Monthly Estimates

Monthly estimates of work completed will be based on the result of soundings taken during the progress of the work. Deductions will be made for dredging and disposal not in accordance with the specifications.

3.4 FINAL EXAMINATION AND ACCEPTANCE

As soon as practicable after the completion of areas, which in the opinion of the Contracting Officer, will not be affected by further dredging operations, each area will be examined by the Government by sounding or sweeping, or both. Remove shoals and lumps by dragging the bottom or by dredging. However, if the bottom is soft and the shoal areas form no material obstruction to navigation, removal may be waived at the discretion of the Contracting Officer. The Contractor will be notified when soundings or sweepings are to be made and will be permitted to accompany the sounding or sweeping party and to inspect the data and methods used in preparing the final estimate. When areas are found to be in a satisfactory condition, the work therein will be accepted as complete. Final estimates will be subject to deductions or correction of deductions previously made because of excessive overdepth, dredging outside or authorized areas, or disposal of material in an unauthorized manner.

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SECTION 02362

COMPOSITE PLASTIC FENDER PILES AND FLOATING LOG CAMELS
11/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(Rev A 1997) Carbon Structural Steel
ASTM A 53	(1997) Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
ASTM D 256	(1997) Determining the Pendulum Inpact Resistance of Plastics
ASTM D 570	(1995) Water Absorption of Plastics
ASTM D 638	(1997) Tensile Properties of Plastics
ASTM D 695	(1996) Compressive Properties of Rigid Plastics
ASTM D 746	(1995) Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 790	(1997) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 4060	(1995) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4329	(1992) Operating Light and Water Apparatus (Flourescent UV and Condensation Type) for Exposure of Plastics

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel

1.2 Metric Units

Due to industry standards the material properties specified herein are in english units.

1.3 SUBMITTALS

Submit the following to the Contracting Officer in accordance with Section 01330, "Submittal Procedures".

1.3.1 SD-02, Manufacturer's Catalog Data

a. Piles G

b. Driving equipment G

1.3.2 SD-04, Drawings

a. Piles G

1.3.3 SD-10, Test Reports

a. Pile Performance G

1.4 DELIVERY AND STORAGE

Deliver and store materials off the ground and protected from damage, in accordance with the manufacturer's recommendations. Piles shall be stored on blocking which is shaped or padded to prevent damage to the pile. Additional piling indicated to be furnished, but not installed, shall be delivered and stacked at a storage location indicated by the Contracting Officer, within 1 miles of the site.

PART 2 PRODUCTS

2.1 PILES

Provide composite plastic piles with fiberglass reinforcing or steel pipe core reinforced as specified. All fender piles and log camels shall be the product of a single manufacturer, unless additional pile manufacturers are approved by the Contracting Officer. Inability of a single pile manufacturer to meet the specified construction period will not be grounds for a time extension. Piles shall be in one piece. Splices will not be permitted. All piles shall be delivered to the job site complete and ready to drive. Pile diameter shall be as follows:

a. Fender Piles: Nominal diameter shall be 330 mm.

b. Floating Log Camels: Nominal diameter shall be 400 mm.

2.1.1 Plastic for Fiberglass or Steel Pipe Core Reinforced

Plastic shall be a mixture of one or more of the following recycled post consumer or post industrial thermoplastics: high density polyethylene, polypropylene and low density polythylene with a minimum of 2.5 percent (by volume) carbon black. The term "recycled" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. No used or rebuilt materials shall be used in the fabrication of the plastic fender piles. Plastic members with cracks or splits width greater than 1/16 inch, especially at the bolterd joints, shall be replaced at the Contractor's expense.

Physical Properties:

Brittleness (Skin) (ASTM D 746)	No breaks at -40 degrees F.

Physical Properties:

Hardness (Skin) (ASTM D 570)	45-55 (Shore D)
Ultimate Tensile Strength (Skin/Core) (ASTM D 638)	500 psi minimum
Compressive Modulus (Skin/Core) (ASTM D 695)	40,000 psi minimum
Water Absorption (ASTM D 570)	Less than 3.0% by weight increase in 24 hours
Ultraviolet (ASTM D 4329 UVA-313)	No more than 1.0% change in Shore Durometer hardness after 500 hours of exposure

2.1.2 Fiberglass Reinforcing

Piles shall have a minimum of eight 1-1/4 inch diameter fiberglass reinforcing bars. The bars shall be on piece. Fiberglass reinforcing shall have the following properties:

Ultimate Tensile Strength (ASTM D 638)	70,000 psi minimum
Flexural Strength (ASTM D 790)	70,000 psi minimum
Compressive Strength (ASTM D 695)	40,000 psi minimum

2.1.3 Steel Pipe Core Reinforcing

The steel pipe core shall be in accordance with ASTM A 53 Grade B, Pipe schedule. Steel plates at pipe end shall be ASTM A 36. Fill pipe core with concrete after installation, minimum compressive strength 2,500 psi.

2.2 Pile Performance

Composite plastic piles shall reinforced to act compositely to provide the following minimum design characteristics:

Maximum allowable Bending Stress:	3,800 psi
Maximum deflection for berthing load of 5,000 pounds for pile length and water depths indicated	10 inches
Stiffiness (EI)	650,000,000 psi
Impact Resistance (skin) (ASTM D 256)	Greater than 4 ft-lb/in.
Abrasion (ASTM D 4060)	Weight loss less than 0.5 g Wear index: 2.5-3.0

Cycles: 10,000

2.3 WELDING

AWS D1.1

PART 3 EXECUTION

3.1 DELIVERY

Composite piles shall be delivered to the job site complete and ready to drive. Each composite pile shall be identified by date of manufacturer, raw plastic batch number, and a unique serial number. Pick up points shall be clearly marked.

3.2 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. Secure piles in their proper alignment.

3.2.1 Driving Equipment

Pile hammers shall be air, steam, or diesel powered, and of an approved type with a capacity at least equal to the hammer manufacturer's recommendation for the total weight of pile and character of subsurface material to be encountered. Minimum driving energy of 8,000 foot-pounds and a maximum of between 15,000 and 25,000 foot-pounds. Weight of the hammer for drop hammers shall not be less than 3,000 pounds. The hammer driving pad shall be supplied by the piling manufacturer. Driving equipment shall be as recommended by the piling manufacturer.

3.2.2 Tolerances in Driving

Piles shall be driven in the locations indicated. Pile tops shall not vary from the design position by more than 50 mm. Remove and replace with new piles those damaged, mislocated, driven below the design cutoff, or driven out of alignment.

-- End of Section --

SECTION 02365

DECK FITTINGS
11/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 148	(1993; Rev. B) Steel Castings
ASTM A 153	(1995)Zinc Coating (Hot Dip) on Iron and Steel Studs
ASTM A 449	(1993) Quenched and Tempered Steel Bolts and Studs
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

FEDERAL SPECIFICATIONS (FED. SPEC.)

FS TT-V-51	Varnish, Asphalt

MILITARY SPECIFICATIONS (MIL. SPEC.)

MIL-C-24707/1	Castings, Ferrous, For Machinery and Structural Applications

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Cleats and Bollards G

b. Grout

c. Bolts, Nuts and Washers G

d. Asphalt varnish

e. Sleeves

f. Aluminum epoxy mastic G

1.2.1 SD-04, Drawings

a. Cleats and Bollards G

Drawings shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, anchorage, and installation with relation to the pier construction.

1.2.2 SD-13, Certificates of compliance

a. Cleats and Bollards

b. Grout

c. Bolts, Nuts and Washers

d. Asphalt varnish

e. Sleeves

PART 2 PRODUCTS

2.1 CLEATS AND BOLLARDS

Cast steel conforming to MIL-C-24707/1 or ASTM A 148 with capacity and dimensions as indicated. Bollards shall have a hole in the top through which concrete shall be deposited after the bollards have been bolted in place.

2.2 GROUT

Grout shall be a mixture of cementitious material and aggregate with a minimum compressive strength of 4000 psi. and a maximum aggregate size of 3/8 inch.

2.3 BOLTS, NUTS AND WASHERS

Bolts and Nuts: ASTM A 449. Washers: ASTM F 436M. Bolts, nuts, and washers shall be hot-dipped galvanized in accordance with ASTM A 153.

2.4 ASPHALT VARNISH

FS TT-V-51.

2.5 SLEEVES

ASTM A 53 zinc coated steel pipe, Type E or S, Grade B, weight class XS (Extra Strong).

2.6 ALUMINUM EPOXY MASTIC

Provide two coats of 5 mils DFT each coat of a high built modified aluminium epoxy mastic where indicated. Surface preparation and mastic application shall be as recommended by the manufacturer. Allow the newly galvanized materials to age prior to application of mastic.

PART 3 EXECUTION

3.1 BOLLARDS AND CLEATS

Bollards shall have a hole in the top through which concrete shall be deposited after the bollards have been bolted in place. Concrete shall fill the cavity completely within each bollard in accordance with Section 03300, "Cast-In-Place Concrete". Provide cement grout pockets for proper installation of the castings. Grout space around bollards and cleats completely filling grout pockets. Recesses in the castings around all anchor bolts shall be filled with hot poured Zinc after the bollard and cleats have been anchored securely and all bolts have been drawn tight. Bollards and cleats shall be shop primed with an asphalt primer and field painted with an asphalt varnish.

-- End of Section --

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SECTION 02396

RESILIENT FOAM-FILLED MARINE FENDERS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM D 412	(1997) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 470	(1993) Crosslinked Insulations and Jackets for Wire and Cable
ASTM D 1052	(1985; R 1994) Measuring Rubber Deterioration-Cut Growth Using Ross Flexing Apparatus
ASTM D 1630	(1994) Rubber Property - Abrasion Resistance (NBS Abrader)
ASTM D 1667	(1976; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam)
ASTM D 2240	(1997) Rubber Property - Durometer Hardness
ASTM D 3575	(1993) Flexible Cellular Materials Made From Olefin Polymers

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1996) Structural Welding Code Steel

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

The Contractor shall provide a fender of his own design which is configured as required by paragraph entitled "Configuration." The Contractor's design shall utilize the products and materials as specified to provide a fender which will meet the general intent of use and the minimum testing requirements. In addition, the Contractor's design shall be adequate to assure a usable ten-year fender life, without major damage. Wherever minimum limits are given in paragraph entitled "Configuration," the Contractor shall construe these minimums to be lower construction limits on his design. These construction minimums shall be exceeded wherever required by the Contractor's design in order to meet the provisions of this specification.

1.2.2 Intent of Use

The intended use of this fender is that the fender shall be mounted to the pier as indicated on the drawings. The vessel, an CG-47, shall be assumed to dock and undock at least 120 times during the fender's 10-year life and will be assumed to impart the energy specified in paragraph entitled "Performance Requirements" to fenders at each docking occurrence. The vessel will approach the berth, contact the fender, and then be positioned longitudinally along the berth to reach its moored position. Each berthing operation will impart the specified energies and forces to each fender including the longitudinal forces specified in paragraph entitled "Fender Pull-Through Test." While moored at a berth, the vessel will impart lateral forces to each fender equal to the sustained loads specified in paragraph entitled "Fender Sustained-Load Test" for a minimum of 200 times for 24 hours each occurrence during its 10-year life.

1.2.3 Performance Requirements

The resilient, foam filled marine fenders shall be designed so that when compressed across its diameter by two parallel flat plates extending the full length and width of the fender, the fender shall absorb 67 metric tons ±15 percent when 60 percent compressed (i.e. to a dimension of 40 percent of its original diameter) with a corresponding load of not more than 117 metric tons ±15 percent. The fender shall also be designed to withstand a sustained reaction force of 110 metric tons for a duration of not less than 24 hours each occurrence for at least 200 occurrences during its 10-year life.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Resilient, foam filled marine fenders G

Include dimensions, material specifications, and method of manufacture.

1.3.2 SD-05 Design Data

a. Resilient, foam filled marine fenders

Submit calculations, including computer analysis and other design data.

1.3.3 SD-10 Test Reports

a. Fender compression test

b. Fender cyclic-compression test

c. Fender sustained-load test

d. Fender pull-through test

e. Elastomeric skin thickness test

Submit copies of reports of tests specified herein. The tests shall have been performed within three years of submittal of the reports for approval. Also, submit reports for tests specified in referenced documents which are applicable to the particular material furnished for use.

1.4 QUALITY ASSURANCE

1.4.1 Elastomer Skin

The elastomer skin of the fender shall be free from cracks, burrs, warpage, checks, chipped or blistered surfaces, and shall have a smooth surface.

1.4.2 Steel Fabrication

The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be detrimental to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. Make bends by controlled means to insure uniformity of size and shape.

1.4.3 Foam Core

The foam core shall be homogeneous and of one piece fabricated construction and shall not be in chip or granular form. The form core shall not contain scraps, strips, or sheets of foam either rolled or stuffed into the required shape unless pieces are bonded together in layers of uniform patterns to form a homogeneous, one piece core. Homogeneous foam rings of adequate thickness to insure performance of the fender are acceptable provided the Contractor can show a minimum 5-year performance of similar fenders.

1.4.4 Welding

AWS D1.1. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

1.5 DELIVERY, STORAGE, AND HANDLING

Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage such as bending or abrading end fittings or cutting of rubber. Protect fenders from exposure to damaging liquids, oils, and greases.

1.6 WARRANTY

Furnish the manufacturer's warranty. The warranty shall be issued directly to the Government and shall not be limited in dollar value. The warranty period shall be not less than 10 years from the date of Government acceptance of the work.

PART 2 PRODUCTS

2.1 CONFIGURATION

Fenders shall have cylindrical mid-bodies with conical or hemispherical shaped ends terminating in an end fitting on the cylinder's centerline at each end. The diameter of the mid-body shall be 2100 mm minimum, and the length of the mid-body shall be 2700 mm minimum. If conical ends are provided, they shall have an angle of 1.05 to 1.31 rad, when measured from the central axis of the fender. The fittings at either end shall be connected through the center of the fender by a chain, shall terminate in a clevis fitting sized for a 44 mm shackle and shall have an integral swivel to allow the end fitting to rotate freely on the axis of the fender. The length of the fender from eye to eye of the end fittings shall be a minimum of 4.3 m. Design end fitting as small as possible to transmit the ultimate load of the shackle to the fender. End fitting shall be sized so as not to contact loading surfaces when the fender is compressed to 30 percent of its original diameter (70 percent compression). Fill interior of the fender with energy absorbing closed-cell foam as specified. The use of chipped or particulate foam is not acceptable.

2.2 FOAM CORE

The energy absorbing foam core shall be a closed-cell cross-linked polyethylene foam with the following properties:

a. Density, ASTM D 1667, 52.86 to 104.12 kg per cubic meter

b. Tensile strength, ASTM D 3575 or ASTM D 412, 552 kPa 80 psi minimum

c. Elongation (ultimate), ASTM D 3575 or ASTM D 412, 40 percent

d. Water absorption percent volume after 24 hour exposure, ASTM D 1667, 5.0 percent maximum

e. Continuous service temperature, -54 to 49 degrees C

f. 25 percent compressive set, ASTM D 1667, 8 percent maximum *

g. 50 percent compressive set, ASTM D 3575, 12 percent maximum *

* Contractor option: Compressive Set of foam core material shall be based on either the 25 percent or the 50 percent requirement listed.

2.3 FENDER SKIN

The outer fender skin shall be minimum 29 mm thick and constructed of elastomer as specified. Reinforcing is optional as required by the Contractor's design. If reinforcing is used, twelve separate filament reinforcing wraps shall be applied as specified under Filament Wrap. The filament wraps shall be evenly distributed in the inner 80 percent to 90 percent of the coating thickness. The outer 10 percent to 20 percent of elastomer shall have no filament reinforcing. The elastomer and filaments shall be applied in a continuous manner to assure adhesion between the various layers. The connection of the skin to the end fittings shall be designed and sized to transmit twice the safe tensile capacity of the chain into the fender skin.

2.3.1 Elastomer

The elastomer used in the fender skin shall be 100 percent PTMEG (polytetramethyleneether glycol) polyether urethane elastomer, with the following unreinforced properties:

a. Shore A. hardness, ASTM D 2240, 80 to 95.

b. Tensile strength, ASTM D 412, 19.3 MPa.

c. Elongation (ultimate), ASTM D 412, 300 percent minimum.

d. Tear strength, ASTM D 470, 1.25 kg per mm minimum.

e. Flex life (Ross), ASTM D 1052, 200,000 cycles minimum.

f. Abrasion resistance (NBS), ASTM D 1630, 100 minimum.

2.3.2 Filament Wrap

If filament reinforcing is required by the Contractor's design, construct each filament reinforcing wrap of continuous filaments applied in a helical pattern, at a helix angle of 0.79 to 1.05 rad to the longitudinal axis of the buoy. A wrap shall consist of two such filament helixes of equal but opposing helix angles. The spacing between the filaments in the same helix shall be no more than 3 mm, measured in a direction parallel to the longitudinal axis of the fender. Each wrap shall extend along the entire longitudinal axis of the fender and shall also encase the fender end fittings and secure them to the fender body.

2.3.3 Filament Reinforcing

If filament reinforcing is required by the Contractor's design, the reinforcing filaments in the outer skin shall be nylon tire cord of 0.00028 kg per m weight with the following properties:

a. Breaking strength, 236 N

b. Elongation (ultimate), 18 percent

2.3.4 Hardware

The internal chain connecting the two end fittings and the two end fittings shall be galvanized in accordance with ASTM A 123 or ASTM A 153/A 153M as appropriate. The chain and end clevis fitting shall have a minimum ultimate tensile capacity of 247 kips. The internal chain and end clevis fitting shall have a minimum ultimate tensile capacity of 578,240 N. Shackles shall be 45 mm and shall have a minimum ultimate tensile capacity of 289,120 N.

2.3.5 Color

Fender skin color shall be black throughout the entire thickness. Galvanized hardware shall be unpainted.

2.3.6 Repairability

The fender casing shall be repairable in the event of tears or punctures in the elastomer skin. The repaired area shall have not less than 90 percent of the properties as specified in paragraph entitled "Elastomer." Required repair materials shall be readily available from the fender manufacturer.

2.4 SOURCE QUALITY CONTROL

2.4.1 Fender Compression Test

Compress fender along its diameter between two parallel flat plate surfaces to a compressed dimension of 40 percent of its original diameter. Record load and the corresponding deflection at 25 mm increments and plot as a graph of load versus deflection. The load-deflection curve shall then be integrated to generate an energy-deflection curve for the fender. The fender shall meet the energy and force performance requirements of the paragraph entitled "Performance Requirements." After compression of the fender to 40 percent of its original diameter (60 percent compression) the fender shall rebound to 90 percent of its original diameter within two minutes after the load is removed, and to 95 percent of its original diameter within 30 minutes after the load is removed.

2.4.2 Fender Cyclic-Compression Test

Compress the fender along its diameter between two parallel flat plate surfaces to a compressed dimension of 40 percent of its original diameter. Release the load and recompress as before. Repeat the compression and release cyclic loadings for a minimum of 10 full cycles of compression. Permanent deformation, cracking, or tearing of the fender skin, fender core, or end fittings shall constitute failure of this test.

2.4.3 Fender Sustained-Load Test

Apply a 117 metric ton compressive load as in paragraph entitled "Fender Compression Test," and hold this load for 24 hours. Record load and deflection each hour. Immediately after release of the load, measure rebound of the fender. Continue to record fender rebound for 24 hours. Failure of the fender or foam core to rebound to 90 percent of its original diameter after 24 hours shall constitute failure of this test. If the foam core is not bonded to the skin of the fender, devise and execute a means for measuring rebound of the foam core and for measuring the void between the foam core and the skin. The maximum rate of compression per minute shall be 20 percent of the total reaction force at 60 percent compression. The full compression cycle, not including rebound, shall take a minimum of 5 minutes.

2.4.4 Fender Pull-Through Test

Devise and perform a test which will measure the resistance of the end fittings and internal chain to pull through the longitudinal axis of the fender. Failure of the chain, end fittings, or skin to resist at least 20.4 metric ton of pull-through tension shall constitute failure of this test. After loading, evidence of permanent deformation, cracking, or tearing of the fender or end fittings shall also constitute failure of this test.

2.4.5 Elastomeric Skin Thickness Test

After delivery of all of the fenders to the construction site and before fender installation, perform a minimum of 3 skin thickness tests per fender for each of 4 fenders to be selected at random by the Contracting Officer. Test locations on the fenders will be selected by the Contracting Officer. Each test shall consist of taking a 6 mm diameter (minimum) to 13 mm diameter (maximum) core from the fender skin which can be removed from the skin and examined for thickness of elastomer and placement of reinforcing (when reinforcing is required). Take skin thickness measurements from the core sample and record measurements noting placement of reinforcing. Where the skin thickness measurement is less than the specified minimum, or the minimum required by the Contractor's design (whichever is greater) by more than 10 percent, reject the fender. In addition, if the average of skin thickness tests for one fender is not equal to or greater than the specified minimum, or the minimum required by the Contractor's design (whichever is greater), reject the fender. If tested fender is rejected, at the option of the Contracting Officer, the Contractor shall then conduct thickness tests for additional fenders. Replace rejected fenders with fenders meeting the provisions of this specification. Test replacement fenders for skin thickness as specified herein. Skin thickness tests will be witnessed by the Contracting Officer. The Contractor shall notify the Contracting Officer 10 working days prior to conducting skin thickness tests. After skin thickness testing, patch core holes with elastomer of the same composition and thickness as the specified elastomer skin. Nylon reinforcing is not required in core hole patches.

PART 3 EXECUTION

3.1 INSTALLATION

Install fenders as indicated on the drawings.

-- End of Section --

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SECTION 02397

ARCH-TYPE RUBBER MARINE FENDERS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36M	(1997; Rev. A) Carbon Structural Steel
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM D 412	(1997) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1996) Rubber Property - Effect of Liquids
ASTM D 573	(1988; R 1994) Rubber - Deterioration in an Air Oven
ASTM D 575	(1991; R 1996) Rubber Properties in Compression
ASTM D 624	(1991) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 746	(1995) Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 2000	(1996) Rubber Products in Automotive Applications
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

MILITARY SPECIFICATIONS (MIL)

MIL-PRF-907	(Rev. E; Am. 2) Antiseize Thread Compound, High Temperature

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-02 Manufacturer's Catalog Data

a. Fender G

b. Hardware

1.2.2 SD-05 Design Data

a. Reaction--energy--percent compression curve

b. Dimension

c. Fender material specifications

d. Design calculations

1.2.3 SD-06 Instructions

a. Installation Instructions

1.2.4 SD-11 Factory Test Reports

a. Minimum Tensile Strength

b. Shore Hardness (Durometer)

c. Modulus at 400 Percent Elongation

d. Maximum Compression Set

e. Tear Resistance

f. Minimum Elongation

g. Ozone Resistance

h. Low Temperature Impact Resistance

i. Water Absorption

j. Heat Resistance

k. Compression Deflection Resistance

l. Fender Compression Test

Tests shall have been performed on the specified fender within 5 years of submittal of the reports for approval. Test reports shall be accompanied by notarized certificates from the manufacturer certifying that the tested material is of the same type, quality, manufacture and make as that proposed to be supplied.

1.3 DELIVERY HANDLING AND STORAGE

Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage, such as bending or abrading end fittings, cutting of rubber, or damage to coating of hardware. Protect fenders from exposure to damaging liquids, oils, greases and extended exposure to sunlight.

PART 2 PRODUCTS

2.1 CONFIGURATION

Fender shall be extruded and shall be continuous in the length indicated. The fenders shall have a truncated "A" cross section shape and be attached to the structure at the base, the widest dimension, of the arch. The connecting hardware shall be fully exposed. No encased hardware or molded fenders shall be allowed. The fender and hardware shall be designed and factory tested to the loads per linear meter of fender specified in paragraph entitled "PERFORMANCE," for angles of approach of 0 and 0.26 rad. Fender anchor bolts and method of anchorage shall be of the size and spacing required by the manufacturer's design and testing; however, the size and spacing of anchor bolts indicated on the drawings shall be construed to be the minimum required, unless exceeded by the requirements of the fender manufacturer's design.

2.2 ELASTOMER

The elastomer shall be the ethylene propylene dimonomer (EPDM), as specified in ASTM D 2000, with the following properties:

ELASTOMER PROPERTY REQUIREMENTS

Minimum Tensile Strength (ASTM D 412)	14 MPa
Shore Hardness (Durometer) (ASTM D 412)	70 $\pm$ 5
Modulus at 400 Percent Elongation (ASTM D 412)	6.2 MPa
Maximum Compression Set (ASTM D 395 Method B, Maximum Percent 22 Hr. @ 70 Degrees C	25 Percent
Tear Resistance (ASTM D 624; DIE B Min. 150 lb/in)	300 lb/in.
Minimum Elongation (ASTM D 412)	500 Percent
Ozone Resistance (ASTM D 1171 Exposure Method B; 70h Bent Loop @ 38 Degrees C; 50pphm)	80 H $\pm$
Low Temperature Impact Resistance (ASTM D 746 Procedure B; Non-Brittle @ -55 Degrees C)	0 Degrees C
Water Absorption (ASTM D 471 Method B;	10.0 Percent

ELASTOMER PROPERTY REQUIREMENTS

70h @ 100 Degrees C.; Volume Change ±5 Percent	
Heat Resistance (ASTM D 573; 70h @ 100 Degrees C Ch Tensile, Elong. -25 Percent, Hardness +10	Shall exceed requirements
Compression Deflection Resistance (ASTM D 575 Method B; 3 S Dwell @ 23 Degrees C	Shall exceed requirements

2.3 HARDWARE

2.3.1 Plates and Angles

ASTM A 36M ,miscellaneous structural shapes and hardware required to attach the fenders to the structure shall be galvanized.

2.3.2 Bolts

ASTM A 325M, galvanized. Limit hardness value to less than Rockwell C-32. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.3.3 Nuts

ASTM A 563M, Grade A, galvanized, heavy hex style, except nuts under M36 may be provided in hex style.

2.3.4 Washers

ASTM F 436M, galvanized.

2.3.5 Antiseize Compound

MIL-PRF-907.

2.4 PERFORMANCE

When vertically compressed by a plate extending the full length and width of a 0.30 m section of the fender, the fender shll ab sorb 8950 joules of energy ±10 percent when 48 percent compressed (i.e., to a dimension of 52 percent of its original height) with a corresponding load of not more than 85,402 N ±10 percent.

2.4.1 FENDER COMPRESSION TEST

Compress fender along its longitudinal axis between two parallel flat plate surfaces to a compressed dimension of 48 percent of its original height. Record load and the corresponding deflection at 6 mm increments and plot as a graph of load versus deflection. The Load-Deflection curve shall then be integrated to generate an Energy-Deflection curve for the fender. After compression of the fender to 48 percent of its original height, the fender shall be rebound to 98 percent of its original height within ten minutes after the load is removed.

PART 3 EXECUTION

3.1 INSTALLATION

Install fenders with the fender longitudinal axis vertical. Install the fenders in the position and at the spacing indicated on the drawings.

3.1.1 Antiseize Compound

Coat threads of bolts prior to applying washers and nuts. Recoat bolt thread projection beyond nut after tightening.

-- End of Section --

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SECTION 02455

PRESTRESSED CONCRETE SHEET PILING

11/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 306.1	(1990) Cold Weather Concreting
ACI 309R	(1996) Consolidation of Concrete
ACI 318M	(1995) Building Code Requirements for Reinforced Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 416/A 416M	(1996) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. B) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997; Rev. A) Portland Cement

ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1998) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and Prestressed Concrete

1.2 DESCRIPTION OF WORK

The work includes the provision of precast, prestressed concrete sheet piling herein referred to as prestressed members. Prestressed members shall be the product of a manufacturer specializing in the production of precast prestressed concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.2.1 Design of Prestressed Concrete Sheet Piles

The structural design shall be the responsibility of the Contractor, and shall be in accordance with ACI 318M and PCI MNL-120. Piles shall be designed utilizing the criteria and design parameters given on the drawings. Piles shall be designed with tongue and groove interlocking.

1.3 BID LENGTH

Bids shall be based on providing piles in the lengths shown. All lengths shown on the drawings are measured from tip to cut-off elevations. All excess of length ordered over the tip to cut-off lengths specified shall be the responsibility of the Contractor, and no additional payment will be made therefore.

1.4 PAYMENT

All cost incidental to providing prestressed concrete sheet piling shall be included in the lump sum contract price bid, including furnishing and driving the piles and further including mobilization, furnishing, installing and removing temporary guides and bracing, predrilling and redriving uplifted piles.

1.5 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.5.1 SD-04 Drawings

a. Drawings for precast prestressed concrete sheet piles. G

1.5.1.1 Content of Drawings

Submit drawings indicating complete information for the fabrication, handling, and erection of the prestressed member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

a. Marking of members for erection;

b. Connections between members, and connections between members and other construction;

c. Prestressing steel details;

d. Schedule and sequence of tensioning and detensioning prestressing strands;

e. Material properties of steel and concrete used;

f. Lifting and erection inserts;

g. Dimensions and surface finishes of each member;

h. Estimated camber;

i. Erection sequence and handling requirements;

j. All loads used in design (such as live, dead, handling, and erection).

1.5.2 SD-05 Design Data

a. Precast prestressed concrete design calculations G

b. Concrete mix design G

1.5.2.1 Design Calculations

Submit calculations reflecting design in accordance with the paragraph entitled "Precast Prestressed Concrete Member Design." Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. Submit calculations for volume change as part of the design calculations.

1.5.2.2 Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.5.3 SD-08 Statements

a. Quality control procedures G

1.5.3.1 Procedures

Submit quality control procedures established in accordance with PCI MNL-116 by the prestressing manufacturer.

1.5.4 SD-10 Test Reports

a. Pozzolan test G

Submit results of pozzolan tests performed within 6 months of submittal date.

1.5.5 SD-11 Factory Test Reports

a. Concrete mix test reports G

1.5.5.1 Requirements

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

1.5.6 SD-18 Records

a. Concrete batch ticket information G

b. Sheet pile installation G

1.5.6.1 Batch Test

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.5.6.2 Sheet Pile Installation

Contractor, at his expense, shall keep a complete and accurate record of each concrete sheet pile incorporated into the permanent structure. The record shall indicate the pile location, pile dimension, original length, ground elevation, tip elevation, cut-off elevation, penetration in blows per foot for each foot of penetration, hammer data including make and size, the rate of operation, type, and dimension of driving helmet, block cap and pile cushion used, and any unusual pile behavior or circumstances experienced during driving such as redriving, heaving, weaving, obstructions, spudding, stops, and others which may occur. Forms for recording pile driving data shall be furnished by the Contractor. Immediately after placing each pile, the Contractor shall turn the records for the pile over to the Contracting Officer.

1.6 QUALITY CONTROL

1.6.1 PCI Quality Certifications

ACI 318M and the PCI MNL-120. Design prestressed members (including connections) for the design load conditions and spans indicated. Design prestressed members for handling without cracking in accordance with the PCI MNL-120.

1.6.1.1 Product Quality Control

PCI MNL-116 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

or

1.6.1.2 Product Quality Control

Plants shall be certified by the PCI Plant Certification Program for category C3 work.

1.6.2 Fabrication, Sampling, and Testing

PCI MNL-116, at the prestressor's option, in lieu of core samples, ACI 318M full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.7 DELIVERY, STORAGE, AND HANDLING

Lift and support prestressed members at the lifting and supporting points indicated on the detail drawings. Store prestressed members off the ground. Separate stacked prestressed members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

PART 2 PRODUCTS

2.1 CONCRETE

ACI 318M, for contractor furnished mix design. The minimum compressive strength of concrete at 28 days shall be 42 MPa, unless otherwise indicated. Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595M Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Grading and Composition

ASTM C 33, Size 57 except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.2.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

2.2.4 Nonshrink Grout

ASTM C 1107.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Accelerating

ASTM C 494, Type C or E.

2.2.5.3 Water Reducing

ASTM C 494, Types A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 706/A 706M, Grade 420; ASTM A 615/A 615M, Grade 420, ASTM A 617/A 617M, Grade 420; or ASTM A 616/A 616M, Grade 420.

2.2.6.2 Welded Wire Fabric

ASTM A 185 or ASTM A 497.

2.2.6.3 Prestressing Strands

a. Seven Wire Stressed Relieved: ASTM A 416/A 416M for low relaxation wire.

2.2.7 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.3 FABRICATION

PCI MNL-116, unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 20 mm, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318M for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between prestressed and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections. Provide curvature or drape of the prestressing strands using approved hold-down devices.

2.3.3 Inserts

When the ends of the prestressed member will be exposed, recess the prestressing stands using inserts. After detensioning, remove inserts and fill the recess with nonshrink grout.

2.3.4 Concrete

2.3.4.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.4.2 Concrete Placing

ACI 304R, ACI 305R for hot weather concreting, ACI 306.1 for cold weather concreting and ACI 309R, unless otherwise specified.

2.3.4.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 85 degrees C. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.5 Prestressing

Do not transfer prestressing forces during detensioning until the concrete has reached a minimum compressive strength of 24 MPa, unless a higher strength is required by the Contractor furnished design.

2.3.6 Surface Finish

Repairs to honeycombed sections located in a bearing area shall be approved by the Contracting Officer prior to repairs. Prestressed members which contain honeycombed sections deep enough to expose prestressing strands shall be rejected. Prestressed members containing hairline cracks which are visible and are less than 0.5 mm in width, may be accepted. However, prestressed members which contain cracks greater than 0.5 mm in width shall be approved by the Contracting Officer. When approved, the member shall be repaired. Any prestressed member that is structurally impaired shall be rejected.

2.3.6.1 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a commercial grade surface finish.

b. Exposed Surfaces: Provide a commercial surface finish.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, check prestressed members for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, prestressed members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new prestressed members.

3.2 WELDING

AWS D1.4 for welding connections and reinforcing splices. Do not weld prestressing strands. Protect the concrete and prestressing strands from heat during welding.

3.3 GROUTING

Clean and fill indicated keyways between prestressed members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.4 DRIVING

Piles shall be driven with an approved diesel air or steam hammer. All piles shall be spaced accurately and shall be driven plumb. Driving of each pile shall be continuous until specified penetration is attained. When approved by the Contracting Officer, jetting, spudding, probing, or similar means shall be provided to obtain the specified tip elevation.

They shall have the head and points squared to the driving axis. All injured piles shall be replaced with sound piles or shall have the damaged parts repaired as directed by the Contracting Officer; without additional cost to the Government.

3.4.1 Pile Hamers

The hamner furnished shall have a capacity at least equal to the hammer manufacturer's recommendation for the total weight of pile and character of subsurface material to be encountered. The required driving energy of the hammer shall be obtained by use of a heavy ram and a short stroke with low impact velocity, rather than a light ram and a long stroke with high impact velocity. The driving energy of the hammer shall be not less than 40,680 joules (30,000 foot pounds) except that for piles weighing less than 545 Kg per meter (400 pounds per foot). The hammer shall deliver not less than 1.4 joules of energy per .5 Kg of pile (one foot-pound of energy per pound of pile). The maximum driving energy shall not exceed that recommended by the manufacturer of the pile. Diesel-powered hammers shall be operated at the rate recommended by the manufacturer throughout the entire driving period. Sufficient pressure shall be maintained at the steam hammer so that : (1) for double acting hammer, the number of blows per minute during and at the completion of driving of a pile is equal approximately to that at which the hammer is rated; (2) for single-acting hammer, there is a full upward stroke of the ram; and (3) for differential type hammer, there is a slight rise of the hammer base during each upward stroke.

3.4.2 Protection of Piles

Care shall be taken to avoid damage to the piles in the placing and driving operations. The top of the pile shall be squared to the longitudinal axis of the pile. If the Contractor elects to use a pile head with projecting mild steel reinforcing, a special driving head shall be used to prevent damage to the reinforcement and prevent direct impact forces from being transmitted through the reinforcement. The special driving head shall include a cushion block adequate to prevent the formation of cracks around the reinforcement during driving, in addition to the other requirements specified hereinafter.

3.4.3 Driving Helmets and Cushion Blocks

A driving head, helmet, or cap will be used between the bottom of the hammer and the top of the pile to absorb the hammer impact and distribute the energy into the pile accordingly. A cushion block of approved design shall be used between the bottom of the hammer and the driving head, helmet, or cap to absorb the hammer impact and still allow for maximum transmission of energy to the pile. A protective layer of planking or dense plywood, not to exceed 125 mm, shall be placed between the top of the pile and the driving head, helmet, or cap to distribute the blow evenly over the face of the pile and prevent spalling. A cushion block is not used with hammer systems using an anvil block, but the protective layer is still required. The driving head, helmet, or cap shall fit loosely around the top of the pile so that the pile may rotate slightly without binding. The entire driving system shall be capable of protecting the head of the pile, minimize energy absorption and dissipation, and transmit hammer energy uniformly and consistently during the entire driving period. During the test pile period the Contractor shall demonstrate to the satisfaction of the Contracting Officer that the equipment to be used on the project performs the above functions. The cushion block may be a solid softwood block with the grain parallel to the end of the pile enclosed in a close-fitting steel housing or manufactured cushion blocks designed for this pupose. Plywood blocks are not acceptable. The thickness of block shall be suitable for the length of pile to be driven and the character of subsurface material to be encountered. The cushion block shall be replaced if it has been damaged, split, highly compressed, charred or burned, or has become spongy or deteriorated in any manner, or if driving has reduced the thickness of the block to 70 percent, or less, of the original block thickness. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy be permitted. The Contactor shall submit to the Contracting Officer, at least two weeks before the start of test pile driving operations, detail drawings of the cushion block, including records of successful use. The type of cushion block used shall not be changed during pile driving operations unless detail drawings are submitted therefor and are approved by the Contracting Officer.

3.4.4 Alignment of Piles

Piles shall be laterally guided during driving, but shall not be unduly restrained from rotation. Guides shall be used mainly for control in maintaining alignment of the face of the bulkhead and shall be located at the approximate elevation of the tie-back system. The Contractor shall be responsible for the design, construction, and removal of the guide system but detail drawings of the proposed system shall be submitted to the Contracting Officer for his review and comment prior to purchasing of any materials for its construction. It should be noted that inserts for construction of the bulkhead facing required that proper orientations of the piles be maintained.

3.4.5 Tolerances in Driving

All piles shall be driven with a variation of not more than 20mm per meter of pile length from the vertical. Top of pile shall be within 75mm of the location indicated. Manipulation of piles to force them into position will not be permitted. All piles will be checked for heave. Piles found to have heaved shall be redriven to the required point elevation.

3.4.6 Spices

Splicing of piles will not be permitted.

3.4.7 Pile Cuttings

Cutting off piles shall be with pneumatic tools, sawing, or other approved means. The use of explosives for cutting will not be permitted. Debris shall not be allowed to fall into the water.

-- End of Section --

PILE DRIVING LOG - CONTRACT NO. ________________________________

BUILDING/STRUCTURE:____ DATE PILE DRIVEN: ________________

CONTRACTOR:____ TYPE OF PILE: ________________

PILE LOCATION:____________________ PILE SIZE (BUTT/TIP):_________________ LENGTH: ________________

GROUND ELEVATION:____ CUT OFF ELEVATION: ________________

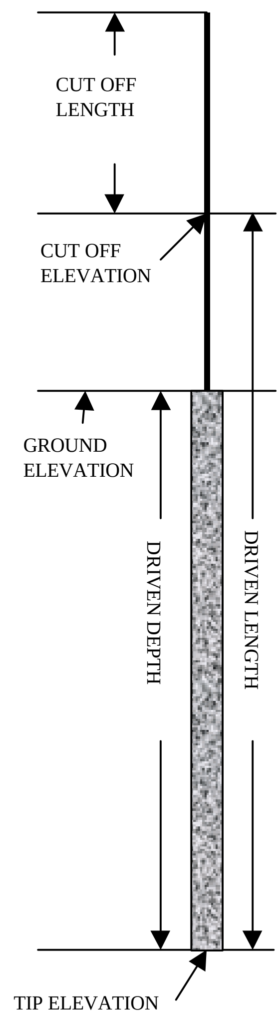
TIME START:____ BATTERED/VERTICAL: ________________

TIME FINISH:____ COMPANY: ________________

HAMMER TYPE:____ INSPECTION: ________________

'DEPTH' COLUMN OF PILE DRIVING RECORD REFERENCED TO: ______________________

DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS
1			41			81		
2			42			82		
3			43			83		
4			44			84		
5			45			85		
6			46			86		
7			47			87		
8			48			88		
9			49			89		
10			50			90		
11			51			91		
12			52			92		
13			53			93		
14			54			94		
15			55			95		
16			56			96		
17			57			97		
18			58			98		
19			59			99		
20			60			100		
21			61			101		
22			62			102		
23			63			103		
24			64			104		
25			65			105		
26			66			106		
27			67			107		
28			68			108		
29			69			109		
30			70			110		
31			71			111		
32			72			112		
33			73			113		
34			74			114		
35			75			115		
36			76			116		
37			77			117		
38			78			118		
39			79			119		
40			80			120		



COMMENTS:

CUT OFF ELEVATION: FROM DRAWING: ________________ PAYMENT:

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = ________________ DRIVEN LENGTH X BID PRICE = ________________

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = ________________ CUT OFF LENGTH X (A) X BID PRICE = ________________

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = ________________ (A) - SPECIFIED RATE, SEE SPECIFICATIONS

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SECTION 02456

PRESTRESSED CONCRETE PILES
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1989) Evaluation of Strength Test Results of Concrete
ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318M	(1995) Building Code Requirements for Reinforced Concrete (Metric)
ACI 318	(1995) Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1995; Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 416/A 416M	(1996) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 421	(1991) Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. A) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates

ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 109/C 109M	(1995) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
ASTM C 136	(1996; Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 227	(1997; Rev. A) Potential Alkali Reactivity of Cement-Aggregate Combinations
ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1995; Rev. A) Blended Hydraulic Cements (Metric)
ASTM C 595	(1994) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1240	(1997) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
ASTM D 1143	(1981; R 1994) Piles Under Static Axial Compressive Load

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1992) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI STD-112	(1984) Standard Prestressed Concrete Piles
PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI JR-119	(1972) Grouting of Post-Tensioned

	Prestressed Concrete
PCI JR-382	(1993) Design, Manufacture and Installation of Prestressed Concrete Piling

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-04 Drawings

a. Piles G

b. Driving helmets, capblocks, and pile cushions G

1.2.1.1 Piles

Prepare in accordance with ACI 315. Indicate placement of reinforcement including tendons. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. Provide certification of a professional engineer registered in any jurisdiction, that layout and details of reinforcement and tendons conform with specified requirements and/or that shown on the structural design drawings.

1.2.1.2 Driving Helmets, Capblocks, and Pile Cushions

Show details of driving helmets, capblocks, and pile cushions. Submit 2 weeks prior to test pile installation.

1.2.2 SD-05 Design Data

a. Concrete mix design G

Submit a concrete mix design thirty days prior to concrete being placed, for each type of concrete used for the piles.

1.2.3 SD-08 Statements

a. Precasting manufacturer's quality control procedures

b. Installation procedures G

c. Suitability of pile driving equipment

d. Geotechnical consultant documentation G

1.2.3.1 Quality Control Procedures

Submit 4 copies of precasting manufacturer's quality control procedures established in accordance with PCI MNL-116.

1.2.3.2 Installation Procedures

a. Submit information on the type of equipment proposed to be used, proposed methods of operation, proposed sequence of driving, batter pile support plan and details of all pile driving equipment and accessories.

b. Provide details of pile driving equipment and a Wave Equation Analysis for selection of the hammer along with a statement of driving procedures. The Wave Equation Analysis is to be completed by the Contractor's geotechnical consultants for each test pile location where different subsurface conditions exist and is to include the following information pertaining to the proposed pile driving equipment:

1. Completed Pile and Driving Equipment Data Form, located at the end of this section, for each proposed pile hammer and pile type combination.

2. Copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analysis shall be run at the estimated tip elevation as well as other required elevations to define maximum stress levels in the pile during driving.

c. Provide detailed procedures for conducting the dynamic pile load test and equipment to be used for conducting the load test. The detailed description shall explain how specific information of pile performance will be evaluated.

1.2.3.3 Geotechnical Consultant Documentation

The services of an independent, registered professional geotechnical engineer, experienced in soil mechanics and Pile Dynamic Analysis, shall be hired by the Contractor to observe test pile installation and job pile installation as specified herein. The geotechnical consultant shall be independent of the Contractor and shall have no employee of employer relationship which could constitute a conflict of interest.

1.2.4 SD-11 Factory Test Reports

a. Aggregates G

1.2.4.1 Aggregates

Prior to pile fabrication, submit certified test reports for the following tests specified in ASTM C 33:

a. Grading

b. Amount of material finer than 75 micrometers sieve

c. Organic impurities

d. Soundness

e. Clay lumps and friable particles

f. Coal and lignite

g. Weight of slag

h. Abrasion of coarse aggregate

i. Fineness modulus

j. Reactive aggregates

k. Freezing and thawing

Submit test reports according to ASTM C 227 for potential alkali-silica reactions, ASTM C 295 for petrographic analysis.

1.2.5 SD-12 Field Test Reports

a. Concrete

b. Test piles G

c. Load tests G

Submit test pile records and load test data. Submit concrete cylinder compressive strength test results.

1.2.6 SD-13 Certificates

a. Prestressing steel G

b. Portland cement G

c. Concrete mix design

1.2.6 Portland Cement

Certification identifying cement; brand name, type, mill location, quantity to be used, size of lot represented by quality control sample, lot number, and destination of shipment.

1.2.7 Concrete Mix Design

Certify, using a Government-approved independent commercial testing laboratory, that proportioning of mix is in accordance with ACI 211.1 or ACI 318M for specified strength and is based on aggregate data which has been determined by laboratory tests during last twelve months.

1.3 REQUIREMENTS

1.3.1 Piling

Provide prestressed pretensioned concrete piles, PCI JR-382. From test pile data the Contractor's Geotechnical Consultant will propose pile lengths for job piles and pile driving and acceptance criteria for subsequent approval by the Contracting Officer in accordance with the paragraph entitled "Test Piles." Base bids on providing the total linear meters (tip to cut-off) of piles as specified in Section 00120, "Supplementary Instructions to Bidders."

1.3.2 Pile Lengths and Quantity

Measurement and Payment

Requirements of "FAR 52.211-18, Variation in Estimated Quantity" shall not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which price shall include items incidental to furnishing and driving the piles including mobilization and demobilization, jetting, predrilling, redriving uplifted piles, an additional 3 m in furnished length for any test pile not driven beyond estimated pile length, and cutting off piles at the cutoff elevation. The cost for additional length of the test piles and the additional 1 meter of job pile required to anchor exposed strands into pile cap shall be included in the total unit price cost for the job. Payment will be made for job and test piles at the bid unit price for the length of pile, from tip to final cutoff, actually provided, excluding buildups and splices directed by the Contracting Officer to be made. Where the tip to cutoff length is less than that calculated from the results of test pile driving and load testing, payment for that portion of pile not driven will be made at 75 percent of the bid unit price and no other payment will be made for making the cutoff. Payment for buildups will be made at 125 percent of the bid unit price. Payment for splices, as specified, will be made at 18 times the unit price per meter bid for all piling. Should the actual cumulative pile length driven (tip to cutoff) vary more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of "FAR 52.236-2, Differing Site Conditions." Piles required to be pulled at no fault of the Contractor will be paid for at the bid unit price for furnishing and driving the pile in its original position plus 25 percent of the amount to cover the cost of pulling. Such pulled piles when redriven will be paid for at 25 percent of the bid unit price for the length driven. Payment for each acceptably provided complete ASTM D 1143 test loading of a single pile will be made at the contract unit price per test, which price shall include furnishing, placing, and removing testing equipment, and placing and removing test loads. At the direction of the Contracting Officer, load tests may be waived at a credit to the Government of the unit price bid therefor.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

ASTM C 150, Type II Low Alkali with blast furnace slag cement conforming to ASTM C 989, Grade 120.

2.1.2 Water

Use potable water.

2.1.3 Aggregates

ASTM C 33 , except as modified herein. Provide aggregate free from any substance which may be deleteriously reactive with alkalies in cement in an amount sufficient to cause excessive expansion of concrete. Do not mix, store in same stockpile, or use fine aggregates from different sources of supply in same concrete mix or same structure without approval.

2.1.4 Fly Ash

As specified in Section 03300, "Cast-in-Place Concrete."

2.1.5 Silica Fume

ASTM C 1240, Silica Fume and high range water reducer shall be of same manufacturer.

2.1.6 Admixtures

If required, ASTM C 494, Type A and ASTM C 618, Type F. Do not use admixtures containing chlorides.

2.1.7 Prestressing Steel

Use seven-wire stress relieved strand conforming to ASTM A 416/A 416M or stress relieved wire conforming to ASTM A 421. Use prestressing steel free of grease, oil, wax, paint, soil, dirt, and loose rust. Do not use prestressing strands or wire having kinks, bends, or other defects.

2.1.8 Reinforcing Steel

ASTM A 615/A 615M, Grade 420 or ASTM A 706/A 706M. Weld reinforcing steel in accordance with AWS D1.4.

2.1.9 Ties and Spirals

Steel, ASTM A 82 for spirals and ASTM A 615/A 615M for ties.

2.1.10 Grout

Provide cement grout for prestressed piles using materials conforming to requirements stipulated herein for concrete mixes or for post-tensioned piles, PCI JR-119. Use admixtures, if required, known to have no injurious effects on steel or concrete. Do not use calcium chloride.

2.2 CONCRETE MIX DESIGN

ACI 211.1 or ACI 318M, Chapter 4. Use concrete with a minimum compressive strength of 35 MPa at 28 days and a maximum size aggregate of 19 mm. Blast furnace slag cement may be used along with Type II Low Alkali Portland Cement with ratios up to 50% by weight. A minimum of 7% to a maximum of 10% by weight silica fume, 25% minimum by weight fly ash and 10 liters per cubic meter calcium nitrate will be used in the mix. Minimum quantity of cementitious material per cubic meter is 400 Kg of which 300 Kg must be Portland cement.

2.3 EQUIPMENT

2.3.1 Pile Hammers

Furnish a hammer capable of developing the indicated ultimate pile capacity considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material to be encountered. Use the same type pile hammer, operating at the same rate and in the same manner, as that used for driving test piles. Obtain required driving energy of hammer, except for diesel hammers, by use of a heavy ram and a short stroke with low impact velocity. At final driving, operate pile hammer in accordance with manufacturer's recommendation for driving either end bearing piles or friction piles. At final driving, operate diesel powered hammers at rate recommended by manufacturer for hard driving. Maintain pressure at steam or air hammer so that: (1) for double-acting hammer, the number of blows per minute during and at completion of driving of a pile is equal approximately to that at which hammer is rated; (2) for single-acting hammer, there is a full upward stroke of the ram; and (3) for differential type hammer, there is a slight rise of hammer base during each downward stroke. Where Pile Dynamic Analyzer is employed in test pile or job pile installation, modify driving as required based upon recommendation of Contractor's Geotechnical Consultant and approval of the Contracting Officer.

2.3.2 Driving Helmets and Cushion Blocks

2.3.2.1 Driving Helmets or Caps and Pile Cushions

Use a steel driving helmet or cap including a pile cushion between top of pile and driving helmet or cap to prevent impact damage to pile. Use a driving helmet or cap and pile cushion combination capable of protecting pile head, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly over top of pile. Provide driving helmet or cap fit sufficiently loose around top of pile so that pile may be free to rotate without binding within driving helmet. During test pile installation, demonstrate to satisfaction of Contracting Officer that equipment to be used on project performs specified function. Use pile cushion of solid wood or of laminated construction using plywood, softwood or hardwood boards with grain parallel to end of pile. Provide pile cushion with thickness of 75 mm minimum and 100 mm maximum and modify thickness as required based upon recommendation of Contractor's Geotechnical Consultant and approval of the Contracting Officer. Replace pile cushion when it becomes highly compressed, charred or burned, or has become spongy or deteriorated in any manner.

2.3.2.2 Hammer Cushion or Capblock

Use a hammer cushion or capblock between driving helmet or cap and hammer ram consisting of aluminum and micarta (or equal) discs stacked alternately in a steel housing. Use steel plates at top and bottom of capblock. Replace aluminum or micarta discs that have become damaged, split or deteriorated in any manner.

2.4 PRODUCT QUALITY CONTROL

Where piling is manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control" perform product quality control in accordance with PCI MNL-116. Where piling is manufactured by specialists or in plants not currently enrolled in the PCI "Certification Program for Quality Control," set-up a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an independent commercial testing laboratory approved by the Contracting Officer in accordance with the following.

2.4.1 Aggregate Tests

Take samples of fine and coarse aggregate at concrete batch plant and test. Perform mechanical analysis (one test for each aggregate size) in accordance with ASTM C 136. Tabulate results of tests in accordance with ASTM C 33.

2.4.2 Strength Tests

Sample concrete in accordance with ASTM C 172 at time concrete is deposited for each production line. Perform slump tests in accordance with ASTM C 143.

Mold cylinders in accordance with ASTM C 31/C 31M. Mold at least six cylinders per day or one for every 45 cubic meter of concrete placed, whichever is greater. Cure cylinders in same manner as piles and for accelerated curing, place at coolest point in casting bed. Perform strength tests in accordance with ASTM C 39. Test two cylinders of each set at 7 days or 14 days, or at a time for establishing transfer of prestressing force (release strength) and removal of pile from forms. Test remaining cylinders of each set 28 days after molding.

2.4.3 Changes in Proportions

If, after evaluation of strength test results, compressive strength is less than specified compressive strength, make adjustments in proportions and water content and changes in temperature, moisture, and curing procedures as necessary to secure specified strength. Submit changes in mix design to Contracting Officer in writing.

2.4.4 Compressive Strength Test Results

Evaluate compressive strength test results at 28 days in accordance with ACI 214 using a coefficient of variation of 10 percent. Evaluate strength of concrete by averaging test results of each set of standard cylinders tested at 28 days. Not more than 10 percent of individual cylinders tested shall have a compressive strength less than specified average compressive strength.

PART 3 EXECUTION

3.1 PILE DRIVING

3.1.1 Driving Piles

Drive piles to reach a driving resistance in accordance with the schedule which the Government will prepare from the test-pile driving data. During initial driving and until pile tip has penetrated beyond layers of very soft soil or below bottom of prejetted holes, use a reduced driving energy of the hammer as directed by the Contracting Officer. If a pile fails to reach indicated tip elevation, or if a pile reaches the required tip elevation without reaching required driving resistance, Notify Contracting Officer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB.

3.1.2 Protection of Piles

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in leads. Take special care in supporting battered piles to prevent excessive bending stresses in pile. Square top of pile to longitudinal axis of pile. Maintain axial alignment of pile hammer with that of the pile. Use a special driving head to drive piles having strands or mild steel reinforcement projecting from head.

3.1.3 Tolerances in Driving

Drive piles with a variation of not more than 2 percent from vertical for plumb piles or more than 4 percent from required angle for batter piles, with pile butt locations being within 100 mm of locations indicated at completion of driving. Maintain and check axial alignment of pile and leaders at all times. If subsurface conditions cause pile drifting beyond allowable axial alignment tolerance, notify Contracting Officer and perform corrective measures as directed. Manipulation of piles not to exceed 100 mm is permitted to bring pile into design alignment. In addition to specified tolerances, maintain a location to provide a clear distance of at least 125 mm from butt to edge of pile cap. If clear distance can not be maintained, then notify Contracting Officer. Check each pile for heave. Redrive heaved piles to required point elevation.

3.1.4 Jetting and Pre-Drilling of Piles

Pre-drilling prior to driving piles shall not be permitted. Jetting shall be employed for all piles but discontinue at a depth approximately 2.0 m above "calculated" tip elevation, and achieve remaining penetration by driving. Jetting method and equipment shall be approved by the Contracting Officer prior to commencing jetting operations. Jetting operation shall be performed using a minimum of 2 jet nozzles, having a minimum diameter of 75 mm and placed symmetrically about the pile perimeter. Before starting final driving set pile to within 300 mm of jetted depth and firmly seat piles in place by application of a number of reduced energy hammer blows.

3.1.5 Splices

Make splices as indicated. Payment will be made as an adjustment to the contract price.

3.1.6 Build-Ups

3.1.6.1 Pretensioned Piles

Where required, pile section may be extended to cut-off elevation by means of a cast-in-place reinforced concrete build-up. Make build-up in accordance with PCI STD-112. Construct build-ups made after completion of driving in accordance with detail, "Build-Up Without Driving." Make build-ups to be driven in accordance with detail "Build-Up With Driving." Have details of means for protecting joints by a suitable mortar or epoxy approved by Contracting Officer. Where build-ups are exposed to water, protect cast-in-place section from water during curing period. Concrete in build-up shall have a minimum compressive strength of 35 MPa. Build-ups will not be permitted on more than 5 percent of total number of piles. If this percent figure is exceeded, or if in the judgment of the Contracting Officer, the clustered location of build-ups is undesirable, withdraw piles of insufficient length and replace with longer piles. Payment for such withdrawal and replacement will be made as an adjustment to the contract price.

3.1.7 Pile Cut-Off

Cut off piles with a smooth level cut using pneumatic tools, sawing, or other suitable methods approved by Contracting Officer. Use of explosives for cutting is not permitted. Where indicated expose strands using hand held methods approved by the Contracting Officer.

3.1.8 Capacity

Safe design capacity for piles is as indicated. The final driving requirements for job piles will be furnished to the Contractor by the Contracting Officer. The Government will use load test and test pile data, knowledge of soil characteristics, experience with existing soil conditions, and other empirical methods in determining the calculated pile tip elevation and the necessary driving resistance. Where piles are not required to be driven to practical refusal, or where the capacities of individual piles or piles groups are not required to be determined by loading test, the safe design capacity will normally be defined as a required maximum average penetration, in inches per blow, for the last 10 blows once the pile tip has achieved the minimum required tip penetration.

3.2 FIELD QUALITY CONTROL

3.2.1 Test Piles

Provide 10 test piles at evenly spaced locations selected by the Contracting Officer, 5 for the 610 mm square piles and 5 for the 457 mm square piles, conforming to the requirements for job piles. Provide test piles 3 meters longer than job pile tip to cut-off length. Record driving data as specified in paragraph titled "Records." If approved after test completion, properly located test piles may be used in the finished work. Fourteen calendar days prior to test pile installation, the Contractor's Geotechnical Consultant, the Contracting Officer and the Contractor shall meet at the Contracting Officer's office to discuss the test pile installation program. All test piles shall be installed under the full time observation of the Contractor's Geotechnical Consultant. Pile driving criteria and pile lengths for job piles will be proposed in writing by the Contractor's Geotechnical Consultant. The Contracting Officer shall have 5 working days to review the results of the testing and determine the minimum depth of tip penetration and approve driving and acceptance criteria for job piles. From these requirements, the Contractor shall prepare a schedule of the number of piles of each length to be used and their location. Submit schedule for approval before any piles, except test piles, are provided. The Government reserves the right to take up to 3 working days to review and approve the Contractor prepared schedule of pile lengths and locations. The excess pile length ordered over the tip to cut-off length listed in the schedule as finally approved shall be the responsibility of the Contractor.

3.2.2 Dynamic Pile Analysis

Use test piles of type as specified elsewhere in this section. Drive test piles at the locations indicated. The contractor shall employ an independent inspection firm, hereinafter referred to as the "Contractors Geotechnical Consultant", experienced in the pile driving process, monitoring of test pile installation, and in the use of the Pile Driving Analyzer and its related equipment. Dynamic Pile analysis shall be performed as follows:

a. Each dynamic pile analysis shall be performed in two steps. The first test will occur on 3 test piles in each size group. The first step is to check the hammer, pile and soil performance, and to determine the suitability of the proposed hammer for the size, length and type of pile being driven for the soil types encountered as the piles are driven. This initial monitoring shall determine whether pre-augering or jetting is appropriate, efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile and extent/location of any pile damage caused by the initial driving. With each blow of the pile the information listed below shall be electronically recorded and analyzed by the Pile Driving Analyzer.

(1) Blow number

(2) Blow rate per minute.

(3) Input and reflected values of force and velocity.

(4) Value of upward and downward traveling force wave with time.

(5) Maximum and final transferred energy to pile, hammer system efficiency.

(6) Maximum compressive stress, velocity, acceleration and displacement.

(7) Maximum tensile stress in pile.

(8) Pile structural integrity, damage detection, extent and location.

(9) Bearing capacity of pile by Case method.

If the pile, hammer and soil performance evaluation recommends changes to the hammer stroke, pile cushioning, augering or any other aspect for the pile driving operation these changes shall be incorporated into production pile driving in an effort to control excessive stresses and pile damage. The first step shall be on the two remaining test piles and the Contractor shall not proceed with further production pile driving until the recommendations made by his Geotechnical Consultant are reviewed and approved of by Contracting Officer, and implemented by the Contractor. This procedure shall be repeated until allowable tensile and compressive stresses are achieved in the pile and/or pile damage is minimized.

b. Upon completion of test pile driving the piles shall be allowed to set-up for at least 48 hours. After evaluation of pile, hammer and soil performance by the Contractors Geotechnical Consultant, the second phase of the dynamic pile analysis may proceed. The second step of dynamic pile analysis is the dynamic load test. The pile(s) with the worst driving record(s) shall be used for dynamic load testing. This portion of the evaluation requires striking the set-up piles a minimum of 20-50 times or as directed by the Contractors Geotechnical Consultant using the same hammer which was used for the test pile driving and which will be used for production pile driving. In addition to those items listed above, selected restrike driving records (as directed by the Contractor's Geotechnical Consultant are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and plot of applied load vs. average pile displacement based on the calculated soil properties.

c. Performance Report:

(1) Upon satisfactory completion of each dynamic load test a minimum of three copies of a Pile Performance Report shall be submitted for the Contractor by the Contractors Geotechnical Consultant. The submittal shall be prepared and sealed by a

Professional Engineer registered in the State of Virginia and shall be made within three working days of the completion of the dynamic load test.

(2) The report for the Dynamic Pile Analysis shall contain the following information:

(a) Bearing capacity of pile from Case Pile Wave Analysis Program (CAPWAP). Information resulting from analysis of a selected restrike blow.

(b) Maximum and final transferred energy, hammer system efficiency.

(c) Maximum compressive stress, velocity, acceleration and displacement.

(d) Maximum tensile stress in pile.

(e) Pile structural integrity, damage detection, extent and location.

(f) Blows per minute and blow number.

(g) Input and reflection values of force and velocity, upward and downward traveling force wave with time.

(h) Pile skin friction and toe resistance distribution.

(i) Maximum energy transferred to pile.

(3) The maximum allowable pile design load will be proposed by the Contractors Geotechnical Consultant based upon the results of a satisfactory pile load test conducted on a pile driven as specified herein and shall include the effects of load transfer to the soil above the foundation stratum.

d. Wave Equation Analysis:

(1) Prior to driving any pile, the Contractor shall submit a pile Wave Equation Analysis, performed by his Geotechnical Consultant, for each size pile and distinct subsurface profile condition. These analyses shall take into account the proposed hammer assembly, pile cap block and cushion characteristics, the pile properties and estimated lengths, and the anticipated soil properties. Only one specific model of pile hammer may be used for each pile type and capacity.

(2) The Wave Equation Analyses shall demonstrate that the piles will not be damaged during driving and shall determine the safe level energy transmission to the pile and indicate the blow count necessary to achieve the required ultimate static pile capacities.

(3) All pile driving equipment furnished by the Contractor shall be subject to the approval of the Engineer. The attached pile driving hammer form shall be completed in full as part of the submittal of the results of the Wave Equation Analyses.

(4) The cost of performing the Wave Equation Analyses shall be

paid for by the Contractor, included in the contract base bid.

e. The equipment to be used for dynamic testing of the pile hammer and soil performance and for dynamic load testing of the test pile shall be a model GCPC Pile Driving Analyzer as manufactured by Pile Dynamics, Inc., of Cleveland Ohio or approved equivalent.

f. All services of the Contractors Geotechnical Consultant shall be paid for by the Contractor. The Contractors Geotechnical Consultant shall be available throughout the pile driving operation to consult with the Contracting Officer when required by the Contracting Officer. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Driving Analysis, shall be at the contractor's expense.

3.2.3 Static Load Tests

Perform load tests on one test pile of each size group in accordance with ASTM D 1143 as modified herein. Perform load tests on test piles directed by the Contractors Geotechnical Consultant and approved by the Contracting Officer. In performing the load test, the ultimate load to be applied shall be two times the safe bearing capacity and the Standard Loading Procedure shall be employed. The load test will be conducted by the Contractors Geotechnical Consultant. Provide facilities for the Contractors Geotechnical Consultant and the Contracting Officer to inspect and measure the deflection or settlement of the pile under test load. Furnish and set up test load equipment and load piles. load test equipment shall not be mobilized until directed. The safe design capacity of a test pile shall be determined by the Contractors Geotechnical Consultant and shall be determined from the results of the load test, and shall be the lesser of the two values computed according to the following:

a. One-half the test load which causes a settlement of 0.25 mm per .9 metric ton of test load.

b. One-half the test load that causes a gross settlement of 25 mm provided the load-settlement curve shows no sign of failure.

3.2.4 Pile Records

Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, penetration in blows per meter for the entire length of penetration for test piles, penetration in blows per meter for the last 3 meters for job piles, hammer data, including rate of operation, make, and size, and any unusual pile behavior or circumstances experienced during driving such as redriving, heaving, weaving, obstructions, and unanticipated interruptions. A preprinted form for recording pile driving data is included at the end of this section. Submit complete and accurate records of installed piles to Contracting Officer within 15 calendar days after completion of the pile driving. Make pile driving records available to the Contracting Officer at the job site, a minimum of 24 hours after each day of pile driving.

-- End of Section --

PILE DRIVING LOG - CONTRACT NO. ____________________

BUILDING/STRUCTURE:____________________ DATE PILE DRIVEN: ____________

CONTRACTOR:____________________ TYPE OF PILE: ____________

PILE LOCATION:____________ PILE SIZE (BUTT/TIP):____________ LENGTH: ____________

GROUND ELEVATION:____________________ CUT OFF ELEVATION: ____________

TIME START:____________________ BATTERED/VERTICAL: ____________

TIME FINISH:____________________ COMPANY: ____________

HAMMER TYPE:____________________ INSPECTION: ____________

'DEPTH' COLUMN OF PILE DRIVING RECORD REFERENCED TO: ____________

DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS
1			41			81		
2			42			82		
3			43			83		
4			44			84		
5			45			85		
6			46			86		
7			47			87		
8			48			88		
9			49			89		
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30			70			110		
31			71			111		
32			72			112		
33			73			113		
34			74			114		
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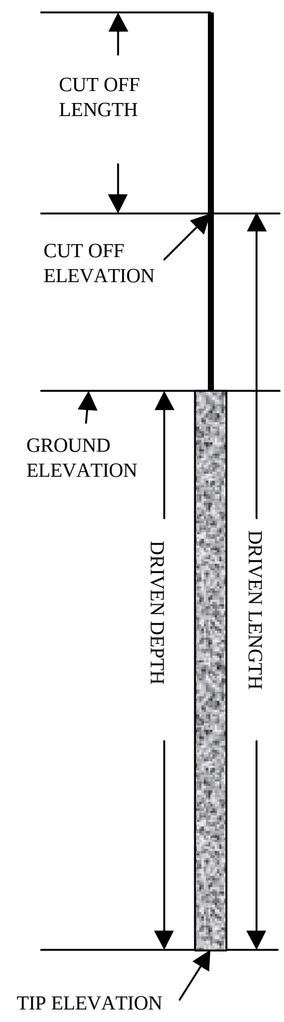
39			79			119		
40			80			120		



COMMENTS:

CUT OFF ELEVATION: FROM DRAWING: ____________

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = ____________

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = ____________

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = ____________

PAYMENT:

DRIVEN LENGTH X BID PRICE = ____________

CUT OFF LENGTH X (A) X BID PRICE = ____________

(A) - SPECIFIED RATE, SEE SPECIFICATIONS

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SECTION 02457

STEEL SHEET PILES
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 328/A 328M	(1993; Rev. A) Steel Sheet Piling

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1996) Structural Welding Code Steel

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-04 Drawings

a. Steel sheet piles G

Submit drawings for approval prior to start of the work or ordering materials. Include details of top protection, special reinforcing tips, tip protection, lagging, splices, fabricated additions to plain piles and driving, cut-off method, and corrosion protection. Drawings for sheet piling including fabricated sections shall show complete dimensions including minimum section properties and details of piling and the driving sequence and location of piling. Include details and dimensions of templates and other temporary guide structures for installing the piling. Provide details of the method of handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

1.2.2 SD-08 Statements

a. Pile pulling method

b. Pile driving equipment

1.2.2.1 Pile Driving Equipment

Submit descriptions of pile driving equipment to be employed in the work to the Contracting Officer for approval. Descriptive information includes manufacturer's name, model numbers, capacity, rated energy, hammer details, cushion material, helmet, templates, and jetting equipment.

1.2.3 SD-18 Records

a. Pile driving record G

1.3 REQUIREMENTS

1.3.1 Basis of Bids

Base bids on pile sections and lengths as indicated. Should the total number of piles or the number of each length vary from that specified as the basis for bidding, an adjustment in the contract price and time for completion will be made. No additional payment will be made for withdrawn, damaged, rejected, or misplaced piles; for any portion of a pile remaining above the cut-off elevation; for backdriving; for cutting off piles, or for any cut off length of piles.

1.4 DELIVERY AND STORAGE

Handle piling using handling holes or lifting devices. Handle long length piles with care to prevent damage. Support on level blocks or racks spaced not more than 3 m apart and not more than 0.60 m from the ends. Supports between multiple lifts shall be in a vertical plane. Protect piling to prevent damage to coatings and to prevent corrosion prior to installation.

PART 2 PRODUCTS

2.1 STEEL SHEET PILES

Meet the requirements specified herein. Heavy gage hot-rolled sheet piling shall conform to ASTM A 328/A 328M. The interlock of sheet piling shall be free-sliding, allow a swing angle of at least 0.09 rad when threaded and maintain continuous interlocking when installed. Sheet piling shall be full-length sections of the dimensions shown. Provide sheet piling with standard pulling holes. Metalwork fabrication for sheet piling sections shall conform to the requirements of Section 05500, "Metal Fabrications."

2.2 STEEL PLATES

Structural steel plates for splices and other fabrication appurtenances shall conform to ASTM A 36/A 36M.

PART 3 EXECUTION

3.1 EARTHWORK

Perform in accordance with Section 02315, "Excavation and Fill." Backfill as indicated.

3.2 INSTALLATION

3.2.1 Pile Hammer

Use a pile hammer having a delivered force or energy suitable for the total weight of the pile and the character of subsurface material to be encountered. Operate hammer at the rate(s) recommended by the manufacturer throughout the entire driving period. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy.

3.2.2 Pile Protection

Use a protecting cap during driving to prevent damage to the top of the sheet piling.

3.2.3 Templates

Prior to driving, provide template or driving frame suitable for aligning, supporting, and maintaining sheet piling in the correct position during setting and driving. Use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the sheet piling until design tip elevation is achieved. Provide at least two levels of support, at third points. Templates shall not move when supporting sheet piling. Fit templates with wood blocking to bear against the web of each alternate sheet pile and hold the sheet pile at the design location alignment. Provide outer template straps or other restraints as necessary to prevent the sheets from warping or wandering from the alignment. Mark template for the location of the leading edge of each alternate sheet pile. If in view, also mark the second level to assure that the piles are vertical and in position. If two guide marks cannot be seen, other means must be used to keep the sheet pile vertical along its leading edge.

3.2.4 Pile Driving

Maintain piling vertical during driving. Drive piles in such a manner as to prevent damage to the piles and to provide a continuous closure. Where possible, drive Z-pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. Incrementally sequence driving of individual piles such that the tip of any sheet pile shall not be more than 1.20 m below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile shall not be more than 0.60 m below any adjacent sheet pile.

3.2.5 Cutting and Splicing

Piles driven to refusal or the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Piles driven below the required top elevation and piles damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed by the Contracting Officer. If directed by the Contracting Officer, splice piles as required to drive them to depths greater than shown on the drawings and extend them up to the required top elevation. Piles adjoining spliced piles shall be full length unless otherwise approved. If splices are allowed in adjoining piles the splices must be spaced at least 3 meters apart in elevation. Welding of splices shall conform to the requirements of Section 05500, "Metal Fabrications." Ends of piles to be spliced shall be squared before splicing to eliminate dips or camber. Splice piles with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced piles shall be free sliding and able to obtain the maximum swing with contiguous piles. Trim the tops of piles excessively battered during driving, when directed at no cost to the Government. Pile cut-offs shall become the property of the Contractor and shall be removed from the site. Use a straight edge in cutting by burning to avoid abrupt nicks. Bolt holes shall be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes shall be reasonably smooth and the proper size for rods or other items to be inserted. Do not use explosives for cutting.

3.2.6 Welding

Shop and field welding, qualification of welding procedures, welders, and welding operators shall be in accordance with AWS D1.1.

3.2.7 Tolerances in Driving

Drive all piles with a variation from vertical of not more than 22 mm per meter. Place the pile so the face will not be more than 150 mm from vertical alignment at any point. Top of pile at elevation of cut-off shall be within 12 mm horizontally and 50 mm vertically of the location indicated. Manipulation of piles to force them into position will not be permitted. Check all piles for heave. Redrive all heaved piles to the required tip elevation.

3.3 INSPECTION

Perform continuous inspection during pile driving. Inspect all piles for compliance with tolerance requirements. Bring any unusual problems which may occur to the attention of the Contracting Officer.

3.3.1 Inspection of Driven Piling

The Contractor shall inspect the interlocks of the portion of driven piles that extend above ground. Remove and replace piles found to be out of interlock.

3.3.2 Pulling and Redriving

The Contractor may be required to pull selected piles after driving to determine the condition of the underground portions of piles. The pile pulling method must be approved by the Contracting Officer. Remove and replace at the Contractor's expense any pile pulled and found to be damaged to the extent that its usefulness in the structure is impaired. Redrive piles pulled and found to be in satisfactory condition.

3.4 INSTALLATION RECORDS

Maintain a pile driving record for each sheet pile. Indicate on the installation record installation dates and times, type and size of hammer, rate of operation, total driving time, dimensions of driving helmet and cap used, blows required per meter for each meter of penetration, final driving resistance in blows for final 150 mm, pile locations, tip elevations, ground elevations, cut-off elevations, and any reheading or cutting of piles. Record any unusual pile driving problems during driving. Submit complete records to the Contracting Officer.

-- End of Section --

PILE DRIVING LOG - CONTRACT NO. ________________________________

BUILDING/STRUCTURE:________________________________ DATE PILE DRIVEN: ________________

CONTRACTOR:________________________________ TYPE OF PILE: ________________

PILE LOCATION:______________ PILE SIZE (BUTT/TIP):____________ LENGTH: ________________

GROUND ELEVATION:________________________________ CUT OFF ELEVATION: ________________

TIME START:________________________________ BATTERED/VERTICAL: ________________

TIME FINISH:________________________________ COMPANY: ________________

HAMMER TYPE:________________________________ INSPECTION: ________________

'DEPTH' COLUMN OF PILE DRIVING RECORD REFERENCED TO: ________________

DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS
1			41			81		
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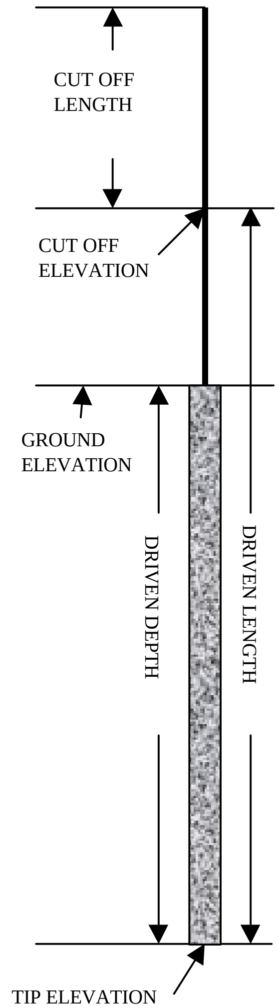

COMMENTS:

CUT OFF ELEVATION: FROM DRAWING: ________________

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = ________________

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = ________________

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = ________________

PAYMENT:

DRIVEN LENGTH X BID PRICE = ________________

CUT OFF LENGTH X (A) X BID PRICE = ________________

(A) - SPECIFIED RATE, SEE SPECIFICATIONS

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SECTION 02465

PRESTRESSED CYLINDER CONCRETE PILES
05/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1989) Evaluation of Strength Test Results of Concrete
ACI 315	(1994) Details and Detailing of Concrete Reinforcement
ACI 318M	(1995) Building Code Requirements for Reinforced Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1995; Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 416/A 416M	(1996) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 421	(1991) Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A 496	(1997) Steel Wire, Deformed, for Concrete Reinforcing
ASTM A 615	(1996) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. A) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field

ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 109/C 109M	(1995) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
ASTM C 136	(1996) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	(1996) Portland Cement
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1995; Rev. A) Blended Hydraulic Cements (Metric)
ASTM C 618	(1996; Rev. A) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1240	(1997) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
ASTM D 1143	(1981; R 1994) Piles Under Static Axial Compressive Load

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1992) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI STD-112	(1984) Standard Prestressed Concrete Piles
PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI JR-119	(1972) Grouting of Post-Tensioned Prestressed Concrete

PCI JR-382 (1993) Dseign, Manufacture and Installation of Prestressed Concrete Piling

1.2 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.2.1 SD-04, Drawings

a. Piles G

b. Driving helmets, capblocks, and pile cushions G

c. Pile driving plan G

d. Batter pile support plan G

1.2.1.1 Piles

Prepare in accordance with ACI 315. Indicate placement of reinforcement including prestressing tendons. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. Provide certification of a professional engineer registered in any jurisdiction, that layout and details of reinforcement and tendons conform with that shown on the structural design drawings.

1.2.1.2 Driving Helmets, Capblocks, and Pile Cushions

Show details of driving helmets, capblocks, and pile cushions. Submit 2 weeks prior to test pile installation.

1.2.2 SD-05, Design Data

a. Concrete mix design G

b. Grout

c. Joint Sealing Material

1.2.3 SD-06, Instructions

a. Dynamic Pile Testing Plan G

b. Interior Inspection for Pile Damage G

Provide instructions and procedures on how the Contractor will assist the Government in the processes of Dynamic Pile Testing and Interior Inspection of Damaged Piles.

1.2.4 SD-07, Schedules

a. Order List

1.2.5 SD-08, Statements

a. Precasting manufacturer's quality control procedures

b. Suitability of pile driving equipment G

1.2.5.1 Quality Control Procedures

Provide a statement of precasting manufacturer's quality control procedures established in accordance with PCI MNL-116.

1.2.5.2 Installation Procedures

Submit installation instructions for pile driving plan and batter pile support plan.

1.2.6 SD-11, Factory Test Reports

a. Aggregates

1.2.6.1 Aggregates

Prior to pile fabrication, submit certified test reports for the following tests specified in ASTM C 33:

a. Grading

b. Amount of material finer than 75 micrometers sieve

c. Organic impurities

d. Soundness

e. Clay lumps and friable particles

f. Coal and lignite

g. Weight of slag

h. Abrasion of coarse aggregate

i. Fineness modulus

j. Reactive aggregates

k. Freezing and thawing

1.2.7 SD-12, Field Test Reports

a. Concrete Strength G

b. Test piles G

c. Load tests G

Submit test pile records and load test data. Submit concrete cylinder compressive strength test results.

1.2.8 SD-13, Certificates

a. Prestressing Tendons

b. Portland cement

c. Concrete mix design

1.2.8.1 Portland Cement

Certification identifying cement; brand name, type, mill location, quantity to be used, size of lot represented by quality control sample, lot number, and destination of shipment.

1.2.9 SD-18, Records

a. Pile records G

Submit pile and test pile records. Submit load test data and results.

1.3 REQUIREMENTS

1.3.1 Piling

Provide prestressed post-tensioned cylindrical concrete piles, PCI JR-382. From test pile data the Government will determine and list "calculated" tip elevations or driving resistances for each pile. This information will be given to the Contractor no later than 10 days from receipt of complete test data. Use this list as the basis for ordering the piles. Do not order piles until list is provided by the Government. Test piles shall be 1.5 meter longer than the bid length.

1.3.1.1 Fabrication Plant Requirements

All piles shall be of new manufacture and shall be produced at a fabricating plant engaged in the manufacture of similar type units. The fabricator shall have successful experience in fabrication of precast cylinder pile units similar to units required for the Project. Fabricator must be an active member of the Precast/Prestressed Concrete Institute (PCI), and the fabricator's precast concrete manufacturing plant shall be certified by the PCI Plant Certification Program prior to the start of production. Certification shall be in the following product groups and categories: B2, B3 or B4.

Alternatively, if the proposed fabrication plant is a non-PCI certified installation, the Contractor shall demonstrate to the satisfaction of the Government, the ability to fabricate the precast and prestressed units in accordance with the Project requirements. The Contractor, at his expense, shall retain the services of an independent testing or consulting firm approved by the Contracting Officer, who shall inspect the fabrication plant at least once per month during the first year of precast and prestressed concrete unit production, and issue to the Contracting Officer a report certified by a qualified Registered Professional Engineer in the state which the non-PCI certified installation is located, that all materials, methods, products and quality control meet all the requirements of the specifications, the plans and the Prestressed Concrete Institute's "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products", MNL-116. The independent testing or consulting firm shall have experience in similar types of inspections of precast operations.

If a report by the independent testing or consulting firm indicates non-conformance with the above requirements, the Contracting Officer, at the expense of the Contractor, may perform an indepedent inspection, and may request acceptance of fabricated units until the fabrication plant complies with the above requirements.

The Contractor's approved fabrication plant shall have sufficient production capacity to produce the required units without causing delay in the work. The Contracting Officer shall reserve the right to inspect the fabrication plant prior to production or at any time during production and meet with the contractor and manufacturer to discuss the facilities, materials, production methods, drawings, and production schedules.

1.3.2 Measurement and Payment

Requirements of "FAR 52.211-18, Variation in Estimated Quantity" shall not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which price shall include items incidental to furnishing and driving the piles including mobilization and demobilization, jetting, predrilling, redriving uplifted piles and cutting off piles at the cutoff elevation. The cost for additional length for the test piles shall be included in the total unit price cost for the job. Payment will be made for job and test piles at the bid unit price for the length of pile, from tip to final cutoff, actually provided, excluding splices directed by the Contracting Officer to be made. Where the tip to cutoff length is less than that calculated from the results of test pile driving and load testing, payment for that portion of pile not driven will be made at 75 percent of the bid unit price and no other payment will be made for making the cutoff. Payment for splices, as specified, will be made at the bid unit price for splices. Should the actual cumulative pile length driven (tip to cutoff) vary more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of "FAR 52.236-2, Differing Site Conditions." Piles required to be pulled at no fault of the Contractor will be paid for at the bid unit price for furnishing and driving the pile in its original position plus 25 percent of the amount to cover the cost of pulling. Such pulled piles when redriven will be paid for at 25 percent of the bid unit price for the length driven. Payment for Restriking the pile at 24 hours as directed by the Contracting Officer will be paid for at the bid unit price. Payment for each acceptably provided complete test loading of a single pile will be made at the contract unit price per test, which price shall include furnishing, placing, and removing testing equipment, and placing and removing test loads. At the direction of the Contracting Officer, load tests may be waived at a credit to the Government of the unit price bid therefor. Payment for Dynamic Pile testing assistance, Bailing out the interior of cylinder piles and Interior Inspections of cylinder piles will be made at the bid unit price respectively.

1.4 DELIVERY, STORAGE AND HANDLING

a. Piles shall be delivered to the Project site in such quantities and at such times to ensure continuity of pile driving and testing operations and adherence to the Project Schedule.

b. Special care shall be taken in handling, transporting, and storing cylinder piles. Piles damaged while being handled or transported will be rejected and shall be replaced or repaired as acceptable to the Contracting Officer at no additional cost to the Government.

c. All cylinder piles shall be stored on solid, non-yielding storage blocks in a manner to prevent torque of objectionable bending.

d. In handling, transporting, and storing piles, the number and location of supports shall be in accordance with the manufacfurer's requirements for the lengths of piles involved. At a minimum the concrete piles shall be handled with cable slings located at the pick-up points as shown on the plans.

e. Cylinder piles shall not be transported from the casting yard until the concrete has reached the minimum required 28-day compressive strength.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

Portland cement conforming to ASTM C 150, Type II low alkali. Blast furnace slag cement conforming to ASTM C 989, Grade 120.

2.1.2 Water

Use potable water.

2.1.3 Aggregates

ASTM C 33 , except as modified herein. Provide aggregate free from any substance which may be deleteriously reactive with alkalies in cement in an amount sufficient to cause excessive expansion of concrete.

2.1.3.1 Fine Aggregates

Shall consist of natural sand having clean, hard, sharp, durable, uncoated grains.

2.1.3.2 Coarse Aggregates

Shall consist of crushed stone (grading size 57 or 67) having clean, hard, strong, durable, uncoated particles.

2.1.4 Fly Ash

As specified in Section 03300, "Cast-in-Place Concrete."

2.1.5 Silica Fume

ASTM C 1240, Silica Fume and high-water reducer shall be of same manufacturer.

2.1.6 Air Entraining Admixtures

Shall conform to the requirements of ASTM C 260.

2.1.7 Prestressing Tendons

ASTM A 416/A 416M, Grade 270, 13 mm diameter, low relaxation steel strands. Tendons shall consist to two(2) strands of seven uncoated wires each. The number and types of tendons per pile shall be as indicated on the plans.

2.1.8 Reinforcing Steel

Spiral wire shall conform to ASTM A 82 plain, cold-drawn steel wire for precast concrete and ASTM A 496 cold-worked, deformed steel wire for cast in place concrete. Deformed bars shall conform to ASTM A 615, Grade 60.

2.1.9 Anchorages and End Fittings

ACI 318M, for post-tensioned assemblies.

2.1.10 Grout

Provide cement grout for prestressed piles using materials conforming to requirements stipulated herein for concrete mixes or for post-tensioned piles, PCI JR-119. Use admixtures, if required, known to have no injurious effects on steel or concrete. Do not use calcium chloride. Grout shall have a minimum compressive strength of 30 MPa in 28 days, as determined by testing 50 mm x 50 mm x 50 mm cubes.

2.1.11 Joint Sealing Material

The abutting joint surfaces of precast segments shall be covered by a sealing material of sufficient thickness to fill all voids between the end surface, except at the core holes for the stressing strands and telltales, when brought together under compression as specified. This sealing material must attain a minimum ultimate compressive strength of 50 MPa in 28 days, and shall be as resistant to exposure and weathering as is the concrete.

2.2 CONCRETE MIX DESIGN

ACI 211.1 or ACI 318M , Chapter 4. The concrete mix portions shall be based on mix designs that have previously been used and can be demonstrated through manufacturer's records to develop 28-day compressive strengths of 50 MPa minimum. Blast furnace slag cement may be used along with Type II Portland cement with ratios up to 50% by weight. A minimum of 7% to a maximum of 10% by weight of silica fume, 25% by weight of fly ash and 10 liters per cubic meter of Calcium Nitrite will be used in the mix. The water-cement ratio shall be maintained below 0.40. Minimum quantity of cementitious material per cubic meter is 400 Kg of which 300 Kg must be Portland cement.

2.3 FABRICATION OF CONCRETE CYLINDER PILES

Fabrication of the concrete cylinder piles, including storage and handling of materials, batching and mixing of concrete, stressing, sampling, testing and recording shall follow the quidelines set forth in PCI MNL-116 "Manual for Quality Control for Plants and Production of Precast and Prestressed Products" unless otherwise noted in the specifications or approved by the Contracting Officer. Test piles shall be identical to and manufactured by the same firm as the production piles.

2.3.1 Pile Sections

Concrete pile sections shall be manufactured by the centrifugal casting process. Individual sections shall be formed and compacted by centrifugal force in a machine of suitable type so designed that the concrete molds may be revolved at speeds sufficient to ensure even distribution and dense packing of concrete without the creation of voids behind reinforcing steel. The wall thickness of pile sections shall be as specified on the plans.

Filling the mold and spinning should be continuous and shall all take place before any of the concrete in the mold has taken an initial set. Excess water forced to the center must be drained or removed prior to curing. The section shall be cured in the mold until the concrere has attained sufficient strength to prevent deformation or damage.

2.3.2 Forms

The forms shall be metal and must be well braced and stiffened against deformation under pressure of the wet concrete during spinning. The portions of the forms which form the end surface of the sections must be a true plane perpendicular to the axis of the sections with the following tolerances: maximum allowable deviation for abutting end surfaces 3 mm., for head end surface 13 mm, and for the bottom end surface 76 mm. Forms shall have smooth joints and inside surfaces accessible for adequate cleaning.

2.3.3 Spiral Reinforcing

Sections shall have a spiral reinforcement cage, arranged and dimensioned as shown on the plans. This reinforcing cage shall be securely held in position during the casting and spinning of the concrete.

2.3.4 Longitudinal Holes

Longitudinal holes for the prestressing tendons shall be formed in the walls of the pile sections during casting. The holes shall be 35 mm (nominal diameter) and positioned so that there will be a minimum cover of 60 mm from the edge of the holes to the outside surface of the pile section. The spiral steel reinforcing shall be outside the tendon holes and shall have a minimum concrete cover of 51 mm to the outside surface of the pile section.

2.3.5 Arrangement of Strands

The number, size, and arrangement of the prestressing strands shall be in accordance with the details shown on the plans.

2.3.6 Steam Curing

The pile sections and forms shall be steam cured immediately after casting. The temperature rise in the curing enclosure shall be uniform, with a rate of rise between -1.1 degrees to 15.6 degrees Celsius per hour, up to a maximum temperature not to exceed 82.2 degrees Celsius. Recording thermometers shall be placed in the curing enclosure. After a minimum of 3 hours of curing at temperatures above 54.4 degrees Celsius, the forms can be removed and the sections placed in a moist curing room for an additional 6 hours.

2.3.7 Concrete Strength

The pile sections shall not be assembled together into a pile until the compressive strength of the concrete has reached 30 MPa as determined by cylinders cured in the same manner as the sections.

2.3.8 Alignment of Sections

Pile sections shall be positioned in accurate alignment so that the axis of the pile does not deviate from a straight line more than 3 mm per 3 m of length. Adjacent sections shall be positioned so that the maximum deviation of the outside surface of the joint will not exceed 6 mm. The abutting joing surfaces shall be covered by a joint sealing material except at the core holes for the stessing. The pile section shall be brought into contact and held together by a force equivalent to not less than 690 kPa on the gross concrete area, while the sealing materials set up.

2.3.9 Post Tensioning

Prestressing tendons shall be tensioned to an allowable unit stress as indicated on the plans. The specified tension shall be measured by the gage pressure of the hydraulic stressing jack and verified by the elongation of the steel strand. The variation in the actual elongation and the calculated elongation shall not be greater than 5%. Tension in the tendons shall be maintained by mechanical end-locks or anchors until final stress transfer.

2.3.10 Grouting

After tensioning all tendons, each tendon hole shall be cleaned and completely filled with grout, including holes not used for tensioning. The pressure of the grout is to be slowly raised to a minimum of 690 kPa but not over 1034 kPa and held for at least one minute. While the grout is curing, the pile shall not be moved or handled in any manner that could damage the pile.

2.3.11 Removal of Anchorage

Transfer of the prestressing force from temporary end locks to grouted tendons shall not be done until the grout has reached a compressive strength of 30 MPa. Prestressing tendons shall be considered to be without slippage from the removal of the end locks when, upon cutting the wires between the end of the pile and the anchor with a burning torch, the wires do not part under stress with a "cup and cone" fracture, but are burned through with the torch.

2.4 FABRICATION TOLERANCES

a. Voids, when used, will be located within +/- 13 mm of position shown on the plans. Pile ends shall be plane surfaces and perpendicular to the longitudinal axis of the pile with a maximum deviation of 6 mm per 305 mm of pile width or diameter, but not to exceed 13 mm. End surfaces shall also be free of spalls. Any end surface which exhibits more than ten percent of the end surface area spalled to a depth of more than 3 mm will be rejected.

b. Accumulated deviation from straightness measured along two perpendicular faces of the pile while not subjected to bending (sweep) shall not exceed 3 mm per 1 m of length.

c. Lengths of individual pile sections shall be within 26 mm of the length specified, with the overall length of a completely fabricated and assembled pile within +152 mm of the overall length specified.

d. Pile diameter shall be +/- 10 mm from the position designated on the plans.

e. Stirrup bars or spirals shall be located longitudinally +/- 19 mm from the position designated on the plans.

f. Strands shall be located within +/- 6 mm of the position designated on the plans.

g. Position of handling devices shall be within +/- 152 mm of the position designated on the plans.

2.5 PLANT INSPECTION

The Contracting Officer shall be notified when casting and/or fabrication of the piles will begin in order that the Contracting Officer may inspect the operation. Final inspection of the fabricated piles will be made at the site, both before and after the pile has been placed in final position. Any pile found to be defective in any manner at any time shall be rejected and replaced by an approved pile or repaired in an acceptable manner at no additional cost to the Government.

2.6 PILE DRIVING EQUIPMENT

Piles shall be driven from a jack-up barge, platform, or floating derrick barge of sufficient size, capacity and stability to handle and install piles of the specified lengths, sizes and dimensions shown on the plans. The equipment shall be of the type generally used in standard pile driving practice and operated in accordance with the manufacturer's recommendations.

2.6.1 Hammer

The pile driving hammer(s) utilized shall be of sufficient type, size, and capacity to consistently deliver effective dynamic energy, suitable to the piles to be driven, without damage, when operating at not less than 60 percent efficiency of the rated driving energy. The minimum rated hammer energy shall be 122,000 joules, with a minimum ram weight of 11,340 kg and a stroke not to exceed 1.1 m.

2.6.2 Driving Helmet

The hammer shall be equipped with a cast steel or structural steel driving helmet with grooved base conforming to the pile shape. Bearing surfaces of the base are to be true and smooth.

Concrete cylinder piles shall be driven with a cushion consisting of laminated ring-shaped 25 mm hardwood boards or 19 mm plywood, with a minimum thickness of 152 mm, cut to fit the head of the pile, and be placed between the driving helmet and the top of the pile. The pile cushion shall be inspected periodically during driving and no driving shall be done with cushions that have been unduly worn or compressed more than 40% of its initial thickness.

2.6.3 Leads

The pile driving leads shall be of such type and height that hold the pile firmly in position and alignment, and in axial alignment with the hammer.

2.6.4 Jetting

The volume and pressure of the water at the jet nozzles and the number of jets used shall be sufficient to freely erode the material adjacent to the jet nozzles.

2.7 PRELIMINARY WORK

a. The Contractor shall perform wave equation analyses using the Federal Highway Administration's Computer Program WEAP for the proposed hammer/pile configuration. Using the subsurface data, pile type and design bearing catacity provided in the plans, the Contractor shall, based on the WEAP analyses and the proposed pile driving equipment, establish the driving criteria and estimated pile stresses during driving. The WEAP analyses and the pile driving criteria shall be submitted to the Contracting Officer for approval within 30 days of written notice to proceed.

b. Order List: The Contractor shall submit to the Contracting Officer for approval an itemized list for precast concrete cylinder piles prior to placing the order with the supplier. The list shall indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile. The ordered length of each pile may, at the option of the Contractor, vary from the pile length as shown to the plans at each location by +610 mm. The Contractor shall review the order list perodically during the driving of production piles, and adjust it as necessary to reduce the number of splices and/or cut-offs, and the amount of build-ups, subject to the approval, and/or upon the direction of the Contracting Officer.

   Loading tests and refined wave equation analyses shall be completed prior to submission of an order list.

c. Pile Length Markings: The Contractor shall mark each pile prior to driving with horizontal lines at 305 mm intervals and the number of feet from pile tip at 1.52 m intervals.

PART 3 EXECUTION

3.1 PILE DRIVING

Piles may be driven when the specified 28-day concrete strength has been achieved but not less than 7 days after casting. Continuously drive piles at locations and to the depths indicated on the plans, and to the required driving resistance established by wave equation analyses (WEAP) and loading test results, as directed by the Contracting Officer and the Contractor's Geotechnical Engineer.

3.1.1 Dynamic Pile Testing

The Contractor will perform dynamic pile testing of all 10 test piles in two steps, 8 in the first and 2 in the second phase using electronic monitoring equipment following a similar procedure with Geotechnical Consultant as outlined in Section 02456, "Prestressed Concrete Piles." Monitoring will include the use of both the Pile Dynamic Analyzer (PDA) for real time data collection in the field and the Case Pile Wave Analysis Program (CAPWAP) for computer post processing of the data. The purpose of dynamic testing is to provide supplemental information for evaluating pile hammer performance, driving stresses, and bearing capacities. Dynamic testing shall be conducted during the entire time piles are initially driven or redriven and during pile restrike testing.

3.1.2 Jetting

Piles may be jetted at any time during driving to a maximum depth corresponding to 2.1 m above the highest permissible pile tip elevation. Care should be exercised during jetting so that excessive internal hydrostatic pressure, which may damage the pile, does not build up anywhere within the pile. Internal jetting will not be permitted without prior written approval of the Contracting Officer. The volume and pressure of water at the jet nozzles shall be sufficient to erode freely the material adjacent to the pile. At least two jet nozzles shall be used and placed symmetrically about the circumference of the pile. Before the highest permissible tip elevation is reached, the jets shall be withdrawn and the piles driven at least 2.1 m or to the depth determined by the Contracting Officer to be necessary to secure the final penetration.

3.1.3 Bailing Out Interior of Piles

During initial pile placement/setting or driving, soil or water may rise inside the pile to levels above the original mudline/water elevation potentially resulting in high internal pressures building up inside the pile. Consequiently, the Contractor shall make observations after pile setting and during pile driving to determine if soil or water is rising within the pile. The Contractor shall bail out soil and/or water to the original elevation(s) or lower as necessary to relieve resultant internal pressures upon approval or direction of the Contracting Officer. Piles damaged by such pressures, as a result of the Contractor's failure to adequately monitor and remove soil or water rise, shall be replaced by the Contractor at no additional cost to the Government.

3.1.4 Interior Inspection for Pile Damage

For all test piles and production piles, when pile damage due to high internal pressures is suspected, when directed by the Contracting Officer, the Contractor shall bail out soil and water from inside the pile to the original mudline or lower, but not closer than 4.6 m from the pile tip, as directed by the Contracting Officer, and inspect the inside of the pile for damage. The Contractor shall provide all required equipment to allow the Contracting Officer to assist in the inspection including: lights, boatswain's chair, lift, oxygen, etc. The Contractor is hereby reminded that he must comply with all applicable OSHA, Federal, and local safety and environmental requirements while performing this work.

During the inspection, all cracking shall be noted as to length, width and depth, and recorded. If any of the crack criteria are not met, the Contractor must modify his approach and continue the process until an accepted driving procedure and equipment are established.

3.1.5 Reduction of Hammer Energy

When the pile tip passes through soft material with little or no resistance to penetration, the Contractor shall take appropriate measures to provide that the pile not be subjected to excessive and undue tensile forces. Such measures may include but are not limited to reducing the hammer energy.

3.1.6 Positioning and Driving Tolerances

The maximum deviation of a pile from the plan position may not be more than

76 mm in any horizontal direction at the cut-off elevation. The cut-off elevation is defined as the elevation 51 mm below the top of pile build-up. Maximum deviation from the vertical or from the batter, shown on the plans shall not be more than 21 mm per meter of length.

3.1.7 Rejection of Piles

Any pile which has been subjected to tensile forces under conditions of low penetration resistance or to abuse resulting in spalling or crushing of the concrete sufficient in the opinion of the Contracting Officer to damage the value of the pile; or which has been damaged, or driven sufficiently far out of location to impair its value to the structure, shall be repaired or removed and replaced with a suitable pile at the Contractor's own expense. No manipulation of any pile to bring it into position or repair will be permitted unless after an inspection of the pile by the Contractor and the Contracting Officer, the Contracting Officer approves in writing such manipulation or repair. All proposed repair methods or procedures must be submitted in writing to the Contracting Officer for approval prior to commencing the repair. Detail sketches of the proposed repair plus a complete description of the proposed repair materials shall be included. All repair work shall be at the Contractor's own expense, with no additional cost to the Government. If, while being moved into position or repaired after approval of such a proposal, the pile is subjected to forces great enough to impair its value as descrided above or the completed repair is found to be unsatisfactory by the Contracting Officer, the pile shall be removed and replaced at the Contractor's own expense. If the bearing capacity of any pile remains in question under any conditions herein described, the Contractor may proof-load test the pile in accordance with Load Test specificatons.

The cost of manipulating, proof-load testing, repairing, or removing and replacing any defective pile shall be borne by the Contractor, and no separate payment will be made therefor.

3.1.8 Cast-In-Place Concrete Build-Up

In the event that the top of any cylinder pile is below the required pile cut-off elevation after the pile has reached the specified driving resistance, the pile shall be built up to the required cut-off elevation with a cast-in-place extension of the cylinder as shown on the plans. Additional driving after placement of a cast-in-place build-up will not be permitted. Maximum height of the build-up shall be 2.4 m.

3.1.9 Splice

In the event that the top of any pile is more than 2.38 m below the specified pile cut-off elevation after the pile has been driven to the required driving resistance, the pile shall be extended with a splice using prestressed precast pile segment(s), with the pile splice (no driving) detail shown on the plans, to within 305 mm or less of the required pile cut-off elevation. Splices shall not be made any lower than 1.2 m above the mean high water elevation.

3.1.10 Splice with Driving

In the event that the required driving resistance is not developed before the pile head has been driven to within 1.2 m of the mean high water elevation, the pile shall be extended with a minimum 4.9 m splice using precast pile segment(s), with the pile splice (with driving) detail shown on the plans. Driving shall continue, after the splice concrete has attained a compressive strength of 35 MPa, and until the required driving resistance is developed.

3.1.11 Restrike

The Contractor shall restrike all test piles and selected production piles to confirm driving resistance a minimum 24 hours after driving, as directed by the Contracting Officer. Pile restrike shall be made for 152 mm of drive, but shall not exceed 50 blows.

3.1.12 Cutting Off

Pile cutoff shall be made only where approved by the Contracting Officer. Cutting of concrete piles may be performed with pneumatic tools or any other method approved by the Contracting Officer. In no case shall explosives be used for cutting. Pile cutoffs will not be measured for separate payment. All associated costs thereof shall be considered incidental to other pile installation items.

Tops of piles which have been damaged during driving shall be cut off and built up or spliced as specified herein, but to the extent damaged, at no additional cost to the Government.

3.1.13 Disposal of Excess Pile Material

Rejected and withdrawn piles and excess pile material resulting from cut-offs or other reasons, shall be removed by the Contractor from the project site.

3.2 FIELD QUALITY CONTROL

3.2.1 Test Piles

Use test piles of type, and drive as specified for piling elsewhere in this section. Drive 10 test piles evenly distributed over the pier site at locations selected by the Contractor. The Government will use Contractor test pile data to determine "calculated" pile tip elevation or necessary driving resistance. Drive test piles at the locations indicated. Drive test piles to indicated tip elevation. Record any increase or decrease in driving resistance. If there is a decrease in driving resistance, a load test, at Government expense, may be required by the Contracting Officer. Use test piles, if located properly and offering adequate driving resistance in finished work. Pre-drilling or jetting is permitted only when test piles clearly establish validity of its use, or as directed by the Contracting Officer.

3.2.2 Load Tests

Perform one load test on Contracting Officer selected pile in accordance with ASTM D 1143 as modified herein. Provide apparatus for applying vertical loads as required by method, using load from weighted box or platform or reaction frame attached to sufficient uplift piles to safely take required load applied to pile by hydraulic jack. Increase load in increments until rapid progressive settlement takes place or until application of total load of 550 metric tons . Consider load test satisfactory when after one hour at full test load gross settlement of pile butt is not greater than gross elastic pile compression plus 0.15 plus one percent of pile tip diameter or width in inches. Slope of gross load-settlement curve under full test load shall not exceed 1.5 mm per metric ton. Make load tests at locations shown on driven test piles. Additional load tests, at Government expense, may be required by the Contracting Officer. Loading, testing, and recording and analysis of data must be under the direct supervision of a Registered Professional Engineer provided and paid for by the Contractor.

3.2.3 Pile Records

For each driven pile, keep a record of the number of blows required for each meter of penetration and number of blows for the last 150 mm penetration or fraction thereof as required for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving. Notify Contracting Officer 10 days prior to driving of test piles and load test. The following log is a preprinted form for recording pile driving data.

-- End of Section --

PILE DRIVING LOG - CONTRACT NO. ___________________________________

BUILDING/STRUCTURE:____ DATE PILE DRIVEN: ____________________

CONTRACTOR:____ TYPE OF PILE: ____________________

PILE LOCATION:_____________________ PILE SIZE (BUTT/TIP):__________________ LENGTH: ____________________

GROUND ELEVATION:____ CUT OFF ELEVATION: ____________________

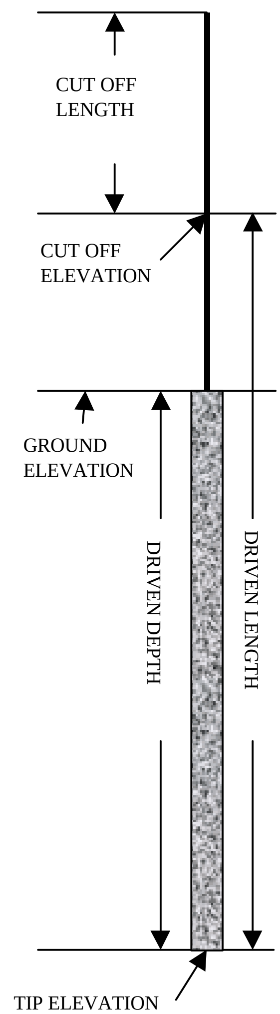
TIME START:____ BATTERED/VERTICAL: ____________________

TIME FINISH:____ COMPANY: ____________________

HAMMER TYPE:____ INSPECTION: ____________________

'DEPTH' COLUMN OF PILE DRIVING RECORD REFERENCED TO: _______________________

DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS	DEPTH IN FEET	BLOWS	REMARKS
1			41			81		
2			42			82		
3			43			83		
4			44			84		
5			45			85		
6			46			86		
7			47			87		
8			48			88		
9			49			89		
10			50			90		
11			51			91		
12			52			92		
13			53			93		
14			54			94		
15			55			95		
16			56			96		
17			57			97		
18			58			98		
19			59			99		
20			60			100		
21			61			101		
22			62			102		
23			63			103		
24			64			104		
25			65			105		
26			66			106		
27			67			107		
28			68			108		
29			69			109		
30			70			110		
31			71			111		
32			72			112		
33			73			113		
34			74			114		
35			75			115		
36			76			116		
37			77			117		
38			78			118		
39			79			119		
40			80			120		



COMMENTS:

CUT OFF ELEVATION: FROM DRAWING: ____________________ PAYMENT:

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = ____________________ DRIVEN LENGTH X BID PRICE = ____________________

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = ____________________ CUT OFF LENGTH X (A) X BID PRICE = ____________________

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = ____________________ (A) - SPECIFIED RATE, SEE SPECIFICATIONS

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SECTION 02510

WATER DISTRIBUTION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME/ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ANSI/ASME B18.5.2.2M	(1982; R 1993) Metric Round Head Square Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 563M	(1993) Carbon and Alloy Steel Nuts (Metric)
ASTM B 32	(1996) Solder Metal
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM D 1248	(1984; R 1989) Polyethylene Plastics Moulding and Extrusion Materials
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping

ASTM D 3139	(1996; Rev. A) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477	(1996; Rev. A) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1995) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C151/A21.51	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153/A21.53	(1994) Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,000 mm Through 1,600 mm), for Water Service
AWWA C500	(1993; Addendum 1995) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(1994) Dry-Barrel Fire Hydrants
AWWA C503	(1988) Wet-Barrel Fire Hydrants
AWWA C508	(1993) Swing-Check Valves for Waterworks Service, 2 in. (50 mm) Through 24 in. (600 mm) NPS
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C511	(1992) Reduced Pressure Principle Backflow Prevention Assembly
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	(1992) Disinfecting Water Mains
AWWA C900	(1989; Addendum 1992) Polyvinyl Chloride

	(PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution
AWWA M9	(1995) Concrete Pressure Pipe
AWWA M23	(1980) PVC Pipe - Design and Installation

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1988) Installation of Polyvinyl Chloride (PVC) Pressure Pipe

UNDERWRITERS LABORATORIES INC. (UL)

UL 246	(1993; R 1997) Hydrants for Fire-Protection Service
UL 262	(1994; R 1997) Gate Valves for Fire-Protection Service
UL 312	(1993; R 1996) Check Valves for Fire-Protection Service

1.2 DESIGN REQUIREMENTS

1.2.1 Materials for Water Piping

Pier Piping: Provide water distribution piping indicated as 100 through 300 mm diameter pipe sizes of ductile-iron pipe or high density polyethylene (HDPE). Pier piping less than 100mm diameter shall be of copper tubing. Also provide water piping accessories, gate valves and freeze protection valves as specified and where indicated.

On-shore piping: Provide water distribution piping indicated as 100 through 300 mm diameter pipe sizes of ductile iron, polyvinyl chloride (PVC or high density polyethylene (HDPE). Also provide water piping accessories, gate valves and check valves as specified and where indicated.

1.2.2 Materials for PW Service Point Piping

Pipe and fittings for service points shall be flanged ductile iron pipe.

1.3 SUBMITTALS

Submit the following in accordance with Section 02001, "Division 02 Submittal Reduction Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Reduced Pressure Backflow Preventer

b. Water Meter

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench and pier. Store plastic piping, jointing materials and rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping (Pier and on-shore piping 100 mm and larger)

a. Pipe and Fittings on pier: Flanged pipe, AWWA C115/A21.15. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

b. Pipe and Fittings on-shore: Pipe, except flanged pipe, ANSI/AWWA C151/A21.51, Thickness Class 50. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

c. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings on shore shall be push-on joints or mechanical joints Joints for pipe and fittings on pier shall be flanged joints.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for set screwed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and conform to the applicable requirements of ASME/ANSI B16.1, Class 250. Setscrews for set screwed flanges shall be 1310 MPa tensile strength, heat treated and zinc-coated steel. Gasket for set screwed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in

AWWA C111/A21.11. Design of set screwed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

(5) Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

(6) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping (On-shore piping)

a. Pipe and Fittings for on shore piping: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent OD. Molecular Oriented (MO) PVC pipe, AWWA C900,shall be plain end or gasket bell end, Pressure Class 150 with cast-iron-pipe-equivalent OD. Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph.

b. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.1.3 High Density Polyethylene (HDPE) Piping

ASTM F 714, DR 9.3. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 1248, Type III, Class C. Pipe and heat-fusion fittings 100 mm and greater shall conform to AWWA 906. Pipe and fittings less than 100 mm shall conform to AWWA C 901. Joints shall be butt fused as per manufacturer's recommendations.

2.1.1.4 Copper Tubing and Associated Fittings

Tubing, ASTM B 88M, Type K. Fittings for solder-type joint, ANSI B16.18 or

ASME/ANSI B16.22; fittings for compression-type joint, ASME/ANSI B16.26, flared tube type.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 1200 kPa, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall be of one manufacturer.

2.1.2.2 Gate Valves Aboveground Location

AWWA C500, AWWA C509. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem type with double-disc gates and flanged ends, (2) AWWA C509 shall be outside-screw-and-yoke rising-stem type with flanged ends. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall be of one manufacturer.

2.1.2.3 Gate Valves (Sizes smaller than 100 mm)

MSS SP-80 and as specified herein. Valves shall be solid wedge, non-rising stem and designed for a minimum hydraulic working pressure of 1700 kPa. Valves shall have flanged or threaded end connections, with unions on both sides of the valve. Provide handwheel operators.

2.1.2.4 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of 1700 kPa . Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. Valves shall be of one manufacturer.

2.1.2.5 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 135 mm . Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.6 Backflow Preventers

AWWA C511 reduced pressure principle type, as modified herein. Backflow preventers shall have flanged connections and galvanized cast-iron or epoxy coated cast-iron construction for sizes larger than 50 mm. The backflow preventer shall include two check valves located between two shut-off valves with an area of reduced pressure between the check valves and a relief device arranged to discharge to the atmosphere. Fluctuation in piping pressure shall not cause cycling. The backflow preventer shall automatically maintain a low pressure zone to positively prevent the backflow of water into the water supply system. The backflow preventer shall automatically indicate failure of any part vital to the prevention of backflow by the continuous discharge of the relief device. The backflow preventer shall be suitable for a cold water working pressure of 1200 kPa. The backflow preventer shall be designed so that any moving part may be replaced without removing the backflow preventer. If supply pressure drops to atmosphere or lower, the diaphragm shall open a relief valve draining water from the reduced pressure zone down to the level of the relief valve.

2.1.2.7 Freeze Protection Valve

Provide self-contained temperature actuated valves where indicated. Valve shall be thermally actuated such that valve automatically opens before the fluid temperature drops to the freezing point. Valve shall have over temperature spring and stainless steel fail safe operating spring. If the thermal system fails, the valve shall open. Valve shall be all bronze with stainless steel springs.

2.1.2.8 Water Meter

AWWA C701, turbine type for customer service. Meter shall register in U.S. gallons. Furnish certificate of testing water meters for conformance to accuracy and capacity requirements in accordance with the applicable AWWA standard.

2.1.2.9 Expansion Joints

At locations where expansion joints are shown in the pier structure, provide ANSI A21.10 mechanical joint solid sleeve expansion joints with ANSI A21.11 gaskets. Retainer glands shall be ductile iron, rated for not less than 1375 kPa. Glands shall be tapped for and provided with retainer gland steel set screws in one gland of each joint; number of set screws shall be as recommended by the gland manufacturer.

2.1.2.10 Fire Department Connections

Provide connections approximately one meter above finish grade, of the approved two-way type with 65 mm National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.

2.1.2.11 Fire Hydrants

Dry-barrel type .

a. Dry-Barrel Type Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 150 mm inlet, 135 mm valve opening, one 115 mm pumper connection, and two 65 mm hose connections. Inlet shall have mechanical-joint or push-on joint end mechanical-joint end only; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502 or AWWA C503 or UL 246. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

2.1.2.12 Pipe Hangers and Supports

Structural steel shapes, plates and rods supporting piping systems shall be in accordance with ASTM A36 and shall be zinc coated (hot-dip galvanized) after fabrication in accordance with ASTM A123. All bolts, nuts and washers used in assembling or attaching hangers and supports shall be zinc coated (hot-dip galvanized) in accordance with ASTM A153. Pipe Clevis, riser, clamp, and pipe rest shall conform to MSS SP-58 and SP-69. Type 1, Type 42, and Type 36 respectively, hot-dip galvanized in accordance with ASTM A 123 and ASTM A 153. Fabrication of steel supporting assemblies shall be as complete as possible before zinc coating. Fabrication shall be smooth and accurate. Bolt holes shall be located and drilled accurately to correct size; enlarging by cutting or burning shall not be allowed. Welding shall conform to AWS D1.1; exposed welds shall be ground smooth.

2.1.2.13 Protective Coating

Protective coating shall be factory or shop applied to the exterior surfaces of all new pier piping, valves, pipe supports/anchors and accessories. Surfaces shall be clean and dry and free from rust, paint, dirt, oil, grease and other foreign matter, and shall be SSPC SP1 solvent cleaned. Coating shall conform to DOD-P-23236 and applied to a dry film thickness of not less than 15 to 18 mils, all in accordance with manufacturer's recommendations. All joint fasteners and all damaged areas of coating shall be field coated to the same thickness as the original coating. Top or seal coat of filed repair shall be provided where required by the coating manufacturer. Galvanized steel piping, valves, and pipe supports/anchors shall be solvent cleaned before application of coal tar coating.

2.1.2.14 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast-iron . Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563M, Grade A; or round-head square-neck type bolts, ANSI B18.5.2.1M and ANSI/ASME B18.5.2.2M with hex nuts, ASME/ANSI B18.2.2. Bolts shall be 16 mm in diameter; minimum number of bolts for each coupling shall be 4 for 100 mm pipe , 5 for 150 mm pipe, and 6 for 200 mm pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.2.15 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 2.5 mm in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 (null)

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Do not lay water lines in the same trench with gas lines fuel lines or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 3.0 m horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 3.0 m, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 450 mm above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 450 mm between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 450 mm between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 6.1 m, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.]

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill."

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports [where indicated and] where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.1.2 Special Requirements for Installation of Water Piping 100 mm and larger

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use set screwed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the set screwed flange manufacturer. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

b. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage on-shore in, trenches. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 15 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Refer to paragraph entitled "Pipe Hangers and Supports" for pipe anchorage on pier.

3.1.2.2 Installation of PVC Plastic Water Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 15 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.3 Installation of High Density Polyethylene (HDPE) Piping

HDPE pipes installed underground shall be installed in accordance with ASTM D 2774. HDPE pipes installed along pier shall be installed in accordance with manufacturer's recommendations.

a. Jointing: Provide butt fused joints in accordance with manufacturer's recommendations.

b. Pipe Anchorage: Provide pipe anchorage in accordance manufacturer's recommendations.

c. Pipe Support: Provide pipe supports along pier in accordance with manufacturer's recommendations. If different locations or additional pipe supports are needed other than those indicated on the drawings, coordinate new pipe support locations with prestressing concrete manufacturer and in accordance with Section 03412 "Plant-Precast Prestressed Structural Concrete".

d. Expansion Joints: Provide for thermal expansion of pipe by installing expansion loops or as recommended by manufacturer.

3.1.2.4 Installation of Valves and Hydrants

a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

b. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install hydrants with the 115 mm connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.3 Installation of Water Piping (100 mm and smaller)

3.1.4 Special Requirements for Installation of Water Piping 100 mm and smaller

3.1.4.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

(1) Screwed Joints: Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

(2) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B 32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

(3) Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

3.1.5 Disinfection

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying non potable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water piping in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water piping in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water piping in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test HDPE piping in accordance with manufacturer's recommendations. No leakage will be allowed for HDPE piping. Test water piping less than 100 mm in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper tubing joints (soldered, compression type, brazed)flanged joints and screwed joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 375 kPa greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 50 mm in diameter, hydrostatic test pressure shall be not less than 1400 kPa. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

-- End of Section --

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SECTION 02530

SANITARY SEWERAGE AND OILY WATER/WASTE (OWWO)
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

MILITARY SPECIFICATIONS (MS)

MS DOD-P-23236A	Paint Coating Systems, Steel Ship Tank Fuel and Saltwater Ballast

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ANSI/ASME B18.5.2.2M	(1982; R 1993) Metric Round Head Square Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47M	(1990; R 1996) Ferritic Malleable Iron Castings (Metric)
ASTM A 48M	(1994) Gray Iron Castings (Metric)
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 563M	(1993) Carbon and Alloy Steel Nuts (Metric)
ASTM A 746	(1995) Ductile Iron Gravity Sewer Pipe
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 443M	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478M	(1996; Rev. A) Precast Reinforced Concrete Manhole Sections (Metric)

ASTM C 923M	(1996) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 924M	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method (Metric)
ASTM C 969M	(1994) Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1997) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1248	(1984; R 1989) Polyethylene Plastics Moulding and Extrusion Materials
ASTM D 2235	(1996; Rev. A) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2680	(1995; Rev. A) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1996) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1996; Rev. A) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996; Rev. A) Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
ASTM D 4101	(1996; Rev. A) Propylene Plastic Injection and Extrusion Materials
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1996; Rev. A) Elastomeric Seals (Gaskets)

	for Joining Plastic Pipe
ASTM F 714	(1997) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1995; Rev. A) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(1996; Rev. A) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C151/A21.51	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153/A21.53	(1994) Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,000 mm Through 1,600 mm), for Water Service
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C900	(1989; Addendum 1992) Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution
AWWA M23	(1980) PVC Pipe - Design and Installation

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27	Fixed Ladders

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-60005	(1988) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1988) Installation of Polyvinyl Chloride (PVC) Pressure Pipe

UBPPA UNI-B-6	(1990) Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer and OWWO Gravity Pipeline

Provide mains and laterals of ductile-iron pressure pipe or high density polyethylene (HDPE)along pier. Provide mains and laterals of ductile-iron gravity pipe, acrylonitrile-butadiene-styrene (ABS) composite plastic pipe, or polyvinyl chloride (PVC) plastic pipe or high density polyethylene (HDPE) on-shore at the Contractor's option.

Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein.

1.2.2 Sanitary Sewer and OWWO Pressure Lines

Provide pressure lines of ductile iron pressure pipe or high density polyethylene (HDPE) along pier. Provide pressure lines of ductile iron pressure pipe, polyvinyl chloride (PVC) plastic pressure pipe or high density polyethylene (HDPE)on-shore at the Contractor's option.

1.3 SUBMITTALS

Submit the following in accordance with Section 02001, "Division 02 Submittal Reduction Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Pipeline materials including joints, fittings, and couplings

Submit manufacturer's standard drawings or catalog cuts.

1.3.2 SD-04 Drawings

a. Precast concrete manhole

b. Metal items

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03300, "Cast-In-Place Concrete"

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

2.1.1 Ductile Iron Gravity Sewer and OWWO Pipe and Associated Fittings

2.1.1.1 Ductile Iron Gravity Pipe and Fittings (On-shore use only)

Ductile iron pipe shall conform to ASTM A 746, Thickness Class 52. Fittings shall conform to AWWA C110/A21.10 or AWWA C153/A21.53. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved by the Contracting Officer, for push-on joint. Fittings shall have strength at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter.

2.1.1.2 Ductile Iron Gravity Joints and Jointing Materials

Pipe and fittings shall have push-on joints or mechanical joints, except as otherwise specified in this paragraph. Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11. Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111/A21.11.

2.1.2 Ductile Iron Pressure Piping

2.1.2.1 Ductile Iron Pressure Pipe and Fittings

Ductile-iron pipe shall conform to ANSI/AWWA C151/A21.51, Thickness Class 52. Flanged pipe shall conform to AWWA C115/A21.15. Fittings shall conform to AWWA C110/A21.10 or AWWA C153/A21.53. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter.

2.1.2.2 Ductile Iron Pressure Joints and Jointing Materials

a. Joints, general: Joints for pipe and fittings shall be push-on joints or mechanical joints except as otherwise specified in this paragraph. Joints for gravity and pressure main piping on pier shall be flanged joints. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint.

b. Push-on joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11.

c. Mechanical joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111/A21.11.

d. Flanged joints: Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and shall conform to the applicable requirements of ASME/ANSI B16.1, Class 250. Setscrews for setscrewed flanges shall be 1310 MPa tensile strength, heat treated, and zinc-coated steel. Gasket for setscrewed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

e. Joints made with sleeve-type mechanical couplings: Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat, two follower rings, two resilient tapered rubber gaskets, and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. Middle ring shall be of cast-iron, and the follower rings shall be of malleable iron or ductile iron. Cast iron shall conform to ASTM A 48M and shall be not less than Class 25. Malleable iron shall conform to ASTM A 47M. Ductile iron shall conform to ASTM A 536. Gaskets shall be designed for long life and resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type; bolts and nuts shall be either of the following: bolts conforming to the tensile requirements of ASTM A 307, Grade A, with nuts conforming to the tensile requirements of ASTM A 563M, Grade A; or round-head square-neck type bolts conforming to ANSI B18.5.2.1M and ANSI/ASME B18.5.2.2M with hex nuts conforming to ASME/ANSI B18.2.2. Bolts shall be 16 mm in diameter; minimum number of bolts for each coupling shall be 4 for 100 mm pipe,5 for 150 mm pipe,6 for 200 mm pipe, 7 for 250 mm pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Sleeve-type mechanical couplings shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.3 ABS Composite Plastic Piping

2.1.3.1 ABS Composite Plastic Pipe and Fittings

ASTM D 2680.

2.1.3.2 Jointing Materials for ABS Composite Plastic Piping

Solvent cement and primer shall conform to ASTM D 2680.

2.1.4 ABS Solid-Wall Plastic Piping

2.1.4.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.4.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.5 PVC Plastic Gravity Sewer Piping

2.1.5.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints. ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm through 1200 mm diameters.

2.1.5.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.6 PVC Plastic Pressure Pipe and Associated Fittings

2.1.6.1 PVC Plastic Pressure Pipe and Fittings

Pipe and fittings 100 mm Diameter to 300 mm: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.6.2 PVC Plastic Pressure Joints and Jointing Material For Pipe 100 mm to 300 mm Diameter.

Joints for pipe shall be push-on joints as specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111/A21.11. Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111/A21.11, respectively, for push-on joints and mechanical-joints.

2.1.7 High Density Polyethylene Pipe (HDPE)

ASTM F 714, DR 9.3. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 1248, Type III, Class C. Joints shall be butt fused in accordance with manufacturer's recommendations.

2.2 Ball Valves

Full port design, copper alloy body, except sizes 65 and larger shall be cast-iron body. Valves shall have two-position, adjustable length lever handles.

2.3 CONCRETE MATERIALS

Concrete materials shall be as specified in Section 03300, "Cast-In-Place Concrete."

2.4 MISCELLANEOUS MATERIALS

2.4.1 Precast Concrete and Associated Materials

2.4.1.1 Precast Concrete Manhole Sections

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478M. Base and first riser shall be monolithic.

2.4.1.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443M ASTM C990M. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923M.

2.4.1.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and valves are listed in the following tables:

Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, kPa	ASTM D 412	12,684	15,132	-
Elongation percent	ASTM D 412	553	295	350
Tear Resistance, N/mm	ASTM D 624 (Die B)	49	28	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11

Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.4.2 Metal Items

2.4.2.1 Frames, Covers, and Gratings for Manholes

CID A-A-60005, cast iron; figure numbers shall be as follows :

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

2.4.2.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443M, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 1.2 m deep.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 3 m to a water main or service line. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 0.60 m below bottom of water line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 3 m on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 0.9 m, horizontal distance, to the water line.

a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 3 m horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 3 m, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 450 mm below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary piping crossing water lines to provide a separation of at least 450 mm between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 450 mm between the bottom of the sanitary piping and the top of the water line.

2. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

3. That the length, minimum 6.1 m, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and fill."

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 7.50 m apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping (cleanouts only)

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11.

3.1.2.3 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved.

b. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94 having a minimum compressive strength of 13.80 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Refer to paragraph entitled "Pipe Hangers and Supports" for pipe anchorage on pier.

3.1.2.4 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.5 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.6 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.7 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

b. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94 having a minimum compressive strength of 13.80 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.8 Installation of HDPE

Refer to section 02510 "Water Distribution" for HDPE pipe installation.

3.1.2.9 Cleanouts

Construct cleanouts of cast iron soil pipe and fittings.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03300, "Cast-In-Place Concrete."

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.5.2 Pipe Hangers and Supports

Structural steel shapes, plates and rods supporting piping systems shall be in accordance with ASTM A36 and shall be zinc coated (hot-dipped galvanized), after fabrication, in accordance with ASTM A123. All bolts, nuts, and washers used in assembling or attaching hangers and supports shall be zinc coated (hot-dip-galvanized) in accordance with ASTM A153. Pipe clevis and riser clamp shall conform to MSS SP-58and SP-69, Type 1 and Type 42 respectively, hot-dip galvanized in accordance with ASTM A153ASTM 153. Fabrication of steel supporting assemblies shall be as complete as possible before zinc coating. Fabrication shall be smooth and accurate. Bolt holes shall be located and drilled accurately to correct size; enlarging by cutting or burning shall not be done. Welding shall conform to AWS D1.1; exposed welds shall be ground smooth.

3.1.5.2.1 Protective Coating

Protective coating shall be factory or shop applied to the exterior surfaces of all new piping, valves, pipe supports/anchors and accessories. Surfaces shall be clean and dry, free from rust, paint, dirt, oil, grease, and other foreign matter and shall be SSPC SP1 solvent cleaned. Coating shall conform to MS DOD-P-23236A and applied to a dry film thickness of at least 15 to 18 mils, all in accordance with manufacturer's recommendations. All joint fasteners and all damaged areas of coating shall be field coated to the same thickness as the original coating. Top or seal coat of field repair shall be provided where required by the coating manufacturer. Galvanized steel piping, valves, and pipe supports/anchors shall be solvent cleaned before application of coal-tar coating.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969M. Make calculations in accordance with the Appendix to ASTM C 969M.

b. Low-pressure air tests: Perform tests as follows:

(1) Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C 924M. Allowable pressure drop shall be as given in ASTM C 924M. Make calculations in accordance with the Appendix to ASTM C 924M.

(2) ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

(3) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.
(4) HDPE: Test in accordance with manufacturer's recommendations.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 345 kPa in excess of the maximum working pressure of the system, but not less than 690 kPa, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test ductile-iron pressure lines in accordance with the requirements of AWWA C600 for hydrostatic testing. Leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; allow no leakage at joints made by other methods. Test PVC plastic pressure lines in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests, using the allowable leakage given therein. Test HDPE piping in accordance with manufacturer's recommendations. No leakage will be allowed for HDPE piping.

-- End of Section --

SECTION 02553

PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM
08/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI MC96.1	(1982) Thermocouples, Temperature Measurement

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M300	(1994) Inorganic Zinc Rich Primer

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.11	(1996) Forged Steel Fittings, Socket-Welding and Threaded
ASME B31.1	(1996) Code for Pressure Piping, Power Piping with Amendments

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A36/A36M	(1996) Structural Steel
ASTM A53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A106	(1997; Rev. A) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A134	(1996) Pipe, Steel, Electric-Fusion(Arc)-Welded (Sizes NPS 16 and over)
ASTM A135	(1996) Electric-Resistance Welded Steel Pipe
ASTM A139	(1996) Electric-Fusion(Arc)-Welded Steel Pipe (NPS 4 and over)
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes

1.2 DEFINITIONS

The following definitions are applicable:

1.2.1 Pre-engineered System

A complete underground heat distribution system including all required components such as carrier pipes, steam pipe, and fittings, anchors, pipe supports, insulation, protective casing, and cathodic protection, for the system supplied. The pre-engineered system does not include valve manholes and the piping and equipment inside the valve manholes. The pre-engineered system shall include all piping and components to a point at least 150 mm inside the building and valve manhole. The UHDS shall not use any part of the building or valve manhole structure as an anchor point.

1.2.2 Direct-Buried

A system which is buried without the need for a field-fabricated protective enclosure such as a concrete trench or tunnel.

1.2.3 UHDS Types

1.2.3.1 Drainable-Dryable-Testable (DDT) Direct-Buried System

A factory-fabricated system including an air and water-tight outer protective casing, air space and an insulated carrier pipe. Drains and vents are provided at the end plates of the system (in manholes or buildings). The drains are normally plugged but the plugs can be removed to drain water which may leak into the air space if there is a failure in the casing or the carrier pipe. The vents allow water vapor to escape and provide a tell-tale sign of leakage.

1.2.4 UHDS Maintenance

The UHDS manufacturer is the company responsible for the design and manufacture of the pre-engineered system. The UHDS manufacturer directs the installation of their system and has a representative on the job site.

1.2.5 UHDS Manufacturer's Representative

The UHDS manufacturer's representative shall be a person who regularly performs the duties specified herein, is certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified herein. The UHDS manufacturer's representative shall be under the direct employ and supervision of the UHDS manufacturer.

1.2.6 Corrosion Engineer

Corrosion engineer refers to a person who by knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control. Such person may be a licensed professional corrosion engineer or a licensed professional engineer certified as being qualified by the National Association of Corrosion Engineers (NACE), if such licensing or certification includes 3 years experience in corrosion control on underground metallic surfaces of the type under this contract. NACE certification shall be corrosion specialist or cathodic protection specialist. The corrosion engineer shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the corrosion engineer shall revisit the site to ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The corrosion engineer shall supervise, inspect, and test the installation and performance of the cathodic protection system.

1.3 DESCRIPTION

1.3.1 Scope

The work includes the design and fabrication; furnishing; installing, and testing of a direct buried underground insulated steam pipe consisting of piping as indicated, cathodic protection system (where required by this specification), together with all fittings and appurtenances necessary for a complete and operable system. Gland type end seals shall not be permitted. Drainable, dryable, testable (DDT) systems with fiberglass casings shall not be provided.

1.3.2 UHDS Design

The UHDS manufacturer shall be responsible for the complete design of the UHDS, the product to be supplied, fabrication, witnessing installation and testing of the system within the design parameters established by the contract drawings and specifications, and in compliance with the detailed design. The complete design of the UHDS shall be sealed by a Professional Engineer in the employ of the UHDS manufacturer.

1.3.3 Contract Drawings

The contract drawings accompanying this specification provide information on:

a. The size of carrier pipes, approximate length, and site location of the system.

b. The routing and elevation of the piping along the route.

c. Location and design of manholes.

d. The obstacles that must be avoided along the path.

e. Location of piping anchors (anchors will be no closer than 1 m nor further than 1.5 m from entrance to manholes and buildings) at manholes and/or buildings. The UHDS manufacturer shall incorporate any additional anchors as needed for their system.

f. Operating pressure and temperature of system.

1.4 SYSTEM REQUIREMENTS

1.4.1 Cathodic Protection

Cathodic protection shall be provided for systems with coated steel casings.

1.4.2 Operating Characteristics

The steam supply system shall have an operating temperature as indicated.

1.4.3 Rated Characteristics

All thermal expansion calculations shall be computed for the supply and return piping using the following design characteristics and installation temperature. The system design conditions for steam supply at a temperature of 260 degrees C. For calculation purposes the installation temperature (the ambient temperature at the site) shall be no higher than a temperature of 5 degrees C.

1.5 STANDARD PRODUCTS

Approval by Contracting Officer is required for products or services of the UHDS manufacturer. The design of the system and equipment provided for this project shall conform to specification requirements, shall be of current production and shall essentially duplicate systems that have been in satisfactory use for at least 5 years, prior to bid opening, at three locations. The systems must have been operated under pressure, temperature and site characteristics that are equal to or more severe than the operating conditions in this specification and must have distributed the same medium. The system shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.6 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.6.1 SD-01 Data

a. Pipe-stress and system expansion calculations G

b. Cathodic protection system calculations G

c. Manufacturer's data sheets G

1.6.1.1 Pipe-Stress and System Expansion Calculations

Pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated three-dimensional analysis, not later than 7 days after notice to proceed.

Calculations (including heat loss calculations) shall demonstrate that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and the anchors and the guides will withstand the resultant forces. Submitted detailed design layout drawings including the location of all anchors and guides. Layout shall also include all analysis node points. As a minimum, the computer analysis results include node stresses, forces, moments and displacements. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer in the employ of the UHDS manufacturer.

1.6.1.2 Cathodic Protection System Calculations

Design life calculations for cathodic protection system, not later than 7 days after notice to proceed. Calculations shall be stamped and signed by a NACE qualified corrosion engineer.

1.6.1.3 Manufacturer's Data Sheets

Manufacturer's data sheets on all components of the UHDS and the instrumentation required for thermal performance testing.

Manufacturer's data sheets for all coatings and for carrier pipe insulation, indicate thicknesses not later than 7 days after notice to proceed.

1.6.2 SD-02 Manufacturer's Catalog Data

a. Pipe

b. Fittings

c. Insulation

d. Cathodic Protection (coordinate with 13114 requirments)

e. Coatings

f. Conduit

g. Field Closures

h. Anchors

1.6.3 SD-04 Drawings

a. Heat distribution system G

1.6.3.1 Heat Distribution System

A complete description of the design and assembly of the system, materials of construction and field installation instructions minimum of 2 days prior to the start of field measurements. Also submittal shall include sufficient system details required to show that the specified minimum insulation thickness has been met. A detailed design layout of the system (plan and elevation views) showing size, type, elevations and location of each component to be used in the system, the design and location of anchors, pipe guides, pipe supports, expansion loops, Z-bends, L-bends, end seals, leak plates, joint locations, pipe and insulation thickness and sizes, types, and movements, connection to manhole and building wall penetrations, and including, if applicable, transition point design to aboveground or other type systems. Also, if applicable, type and details of the cathodic protection system to be used. Detailed design layout drawings shall be prepared and approved by a registered Professional Engineer as certified by their stamp.

1.6.4 SD-08 Statements

a. Work plan G

b. Quality assurance

c. Thermal performance testing G

1.6.4.1 Work Plan

A proposed schedule of activities indicating when various items of work and tests are to be carried out and when the representative of the UHDS manufacturer shall be present at job site. The UHDS manufacturer shall submit a list of what characteristics shall be considered damaged or defective materials that must be replaced.

1.6.4.2 Quality Assurance Plan

Manufacturer's quality assurance plan for fabrication, delivery, storage, installation and testing of system.

1.6.4.3 Thermal Performance Testing

A proposed test procedure and proposed samples of test data sheets for each required test, 30 days prior to the proposed test date. The procedure shall contain a complete description of the proposed test with calibration curves or test results furnished by an independent testing laboratory of each instrument, meter, gauge, and thermometer to be used in the tests. The test shall not commence until the procedure has been approved.

1.6.5 SD-09 Field Test Reports

a. WSL system test G

1.6.5.1 WSL System Test

Assembly test of WSL system for steam and/or condensate return service.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

1.6.6 SD-13 Certificates

a. UHDS manufacturer certification G

b. UHDS design G

c. Certificate of compliance G

d. Testing firm qualification G

e. Welds G

1.6.6.1 UHDS Manufacturer Certification

Certification that the UHDS manufacturer regularly and currently manufactures direct-buried systems, and that the designs of the system and equipment to be provided for this project conform to specification requirements. This certification shall be an original signed by a principal officer of the UHDS manufacturer and shall be submitted at minimum of 2 weeks prior to start of work.

1.6.6.2 UHDS Design

A Certificate of Satisfactory Operation certifying that at least 3 systems installed by the UHDS manufacturer within the previous 10 years, have, and are operating satisfactorily for not less than 5 years, not later than 7 days after notice to proceed. The certificate shall indicate the location, type of system, size of system, point of contact (POC) including phone number, for information verification. This certificate of satisfactory operation shall be an original signed by a principal officer of the UHDS manufacturer.

1.6.6.3 Certification of Compliance

Upon completion of the work, and before final acceptance, a notarized statement signed by a principal officer of both the UHDS manufacturer and the contractor, certifying that the system has been installed satisfactorily and in accordance with the contract drawings, specifications, UHDS manufacturer's detailed design layout drawings and with the UHDS manufacturer's recommendations.

1.6.6.4 Testing Firm Qualification

A Certificate of the Testing Firm Qualification from the independent testing firm or firms, not later than 7 days after notice to proceed, certifying that: weld examination methods and procedures, and the interpretation of radiographic films will be performed in accordance with ASME B31.1; the firm intends to utilize the proper film exposure, techniques, and penetrameter to produce density and geometric sharpness in sufficient clarity to determine presence of defects; and that all radiographic films will be reviewed and interpreted, and reading reports signed, by not less than a Certified American Society for Nondestructive Testing Level III Radiographer.

1.6.6.5 Welding

A Certification of Acceptability of all welds made in the field, upon completion of the project. This certification shall consist of a letter signed by an official of the independent testing firm or firms examining welds, stating that all provisions of this specification have been complied with, and that all welds inspected radiographically have met the acceptability standards specified.

1.6.7 SD-18 Records

a. Daily written report

1.6.7.1 Daily Written Reports

A daily written report from the representative of the UHDS manufacturer whenever the representative is required to be on the jobsite. The report shall be checked for accuracy and the original shall be submitted no later than the next working day after the date of the report. One copy shall be forwarded to the UHDS manufacturer's main office. The report shall be signed by the representative. The report shall state whether or not the condition and quality of the materials and methods used and the installation of the system are in accordance with the contract drawings, specifications, and the UHDS manufacturers detailed design layout drawings and requirements. If anything connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the UHDS manufacturer's recommendations for corrective action and when the unsatisfactory condition is to be corrected. The daily report will track and report all unsatisfactory conditions and corrective measured being taken. The report shall identify any conditions that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper valve manhole entries and changes required to the UHDS design due to interferences or conflicts, upon realization of interferences or conflicts. On a weekly basis the daily reports shall be reviewed, approved, signed and sealed by the registered Professional Engineer responsible for the system design and shall be submitted to the Contracting Officer.

1.6.8 SD-19 Operation and Maintenance Manuals

a. Heat distribution system, data package 2

1.6.8.1 Heat Distribution System, Data Package 2

The operation and maintenance manual for the heat distribution system shall list routine maintenance procedures, possible breakdowns and repairs, procedures for recording conduit temperatures biannually, and troubleshooting guides. Manual shall include as-built piping layout of the system including final elevations.

Submit in accordance with Section 01781, "Operation and Maintenance Data."
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TABLE A
SITE CLASSIFICATION DEFINITION
BASED ON KNOWN UNDERGROUND WATER CONDITIONS

Site Classification	General Conditions for Classification
Severe	The water table is expected to be frequently above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system. OR The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system.
Bad	The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for short periods (or not at all) in the soil surrounding the system OR

TABLE A
SITE CLASSIFICATION DEFINITION
BASED ON KNOWN UNDERGROUND WATER CONDITIONS

Site Classification	General Conditions for Classification
	The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for short periods in the soil surrounding the system.
Moderate	The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for short periods (or not at all) in the soil surrounding the system. OR The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for brief or occasional periods in the soil surrounding the system. OR The water table is expected never to be above the bottom of the system and surface water is not expected to accumulate or remain in the soil surrounding the system.

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Classification of the site conditions for the UHDS was based on ASTM D 2487 and the following criteria: Table A, Severe.

PART 2 PRODUCTS

2.1 FACTORY FABRICATED, DIRECT-BURIED, DRAINABLE, DRYABLE, TESTABLE (DDT) SYSTEMS

2.1.1 DDT Steam Carrier Pipes

Requirements shall be in accordance with the "Heat Distribution Piping" paragraph.

2.1.2 DDT Condensate Carrier Pipes

Carrier piping for condensate return systems shall be steel, schedule 80. Pipe requirements shall be in accordance with the "Heat Distribution Piping" paragraph.

Do not locate condensate pipes in conduit casings which contain steam pipes or any other piping.

2.1.3 DDT Carrier Pipe Insulation

Carrier pipe insulation shall conform to minimum thicknesses and type listed in Tables 1 and 2 as required for temperature in carrier pipe specified under the "Rated Conditions" paragraph.

2.1.4 Insulation Banding and Scrim

Stainless steel bands and clips, at least 13 mm wide, ASTM A167 (304 stainless steel), maximum spacing 460 mm shall be used over the scrim to secure the insulation onto the carrier pipe. A minimum of two bands are required for each 1300 mm section of insulation. Vinyl-coated fiberglass scrim, Fed. Spec. L-S-125, Type II, Class 2, with 18 x 16 mesh (number of filaments per inch) and made of 0.335 mm diameter vinyl-coated fibrous glass yarn. Bands are used over the scrim to secure the insulation onto the carrier pipe.

2.1.5 Casing

Smooth-wall steel, electric resistance spiral welded, conforming to ASTM A134, ASTM A135, or ASTM A139 and the values tabulated below. Provide eccentric connectors as necessary between casing sections to provide drainage of casing section between manholes and between manholes and buildings.

Casing Diameter (mm)	Minimum Thickness (mm)
150 - 660	6.35
675 - 900	6.35
940 - 1050	6.35
1170	6.35

2.1.6 Casing End Plates, Vents, and Drains

End plates shall be made of ASTM A36/A36M steel, minimum thickness 13 mm for conduit pipe sizes above 300 mm and 9.5 mm for conduit pipe sizes 300 mm and less. Provide 25 mm ASTM A53, Sch 40, galvanized vent riser pipe on end plate vent opening. Vent pipe shall extend to top of manhole and terminate 300 mm above grade with a bend. Provide 25 mm drain at the bottom and vent at the top. Construct with welded steel half coupling welded to the end plate, and brass plugs. Plug drains, do not plug vents.

2.1.7 Air Space

Provide continuous 25 mm minimum air space between carrier pipe insulation and casing.

2.1.8 Casing Coating

Fusion-bonded epoxy, minimum thickness 1.0 mm. Rated by coating manufacturer for continuous service for at least 25 years at temperatures of 232 degrees C and having a coefficient of expansion similar to that of steel. Coating shall be applied in accordance with the coating manufacturer's instructions. Factory-inspect for holidays and make repairs as necessary.

2.1.9 Coating of End Plates and conduit Sections Extending in Manholes

Zinc-rich coating that conforms to AASHTO M300, Type IA except that volatile organic compounds shall not exceed 0.34 kg per liter. The zinc rich coating shall be applied in accordance with the coating manufacturer's requirements including surface preparation. No additional top coat shall be applied.

2.1.10 Carrier Pipe Guides

Maximum spacing 3 m on centers, no more than 1500 mm from pipe ends, minimum of three guides per elbow section. Guides shall be designed to allow thermal expansion without damage, provide proper pipe guiding, and to allow horizontal movement in two directions as required at expansion loops and bends. Design of supports shall permit flow of water and air through the support. Pipe insulation shall extend thru the pipe guides and be protected by steel sleeves. Design of guides shall be such that no metal to metal contact exists between the casing and the carrier pipe. Insulation or non-metallic material used to ensure no metal to metal contact shall be designed to not be compressed by the weight of the carrier pipe when full of water.

2.1.11 Anchor Plates

Anchor plate shall be ASTM A36/A36M steel, welded to carrier pipe and casing, 13 mm minimum thickness and shall include, passages for air flow and water drainage through the annular air space in the system. Exterior surface of the anchor plate shall be coated with the same coating material as the casing.

2.1.12 Field Connection of Casing Sections

Steel section conforming to casing specification, welded to casing sections, coated on all surfaces with UHDS manufacturer's coating field repair compound, and covered with a 1.3 mm minimum thickness polyethylene shrink sleeve designed for a service temperature exceeding 260 degrees C.

2.1.13 Manufacturer's Identification

Provide embossed brass or stainless steel tag hung by brass or stainless steel chain at each end of each conduit or insulated piping in the manholes and buildings. The tag shall identify UHDS manufacturer's name, date of installation, Government contract, and manufacturer's project number.

2.2 FACTORY FABRICATED, DIRECT-BURIED, WATER-SPREAD-LIMITING (WSL) SYSTEM

2.2.1 Steam/High Temperature Hot Water Carrier Pipes

Refer to Paragraph, HEAT DISTRIBUTION PIPING for pipe material requirements. The pipe shall be steel with the ends machined and metallized to provide a satisfactory sealing surface for the sealing rings. The metallizing shall be a high nickel alloy applied to an excess thickness and then machined to the required OD.

2.2.2 Condensate Carrier Pipes

Carrier piping for condensate return systems shall be steel, schedule 80. Refer to Paragraph, HEAT DISTRIBUTION PIPING for pipe requirements. Condensate piping shall not be located in casings which contain steam piping or any other piping.

2.2.3 Casing for Steam and Condensate

The casing shall be reinforced thermosetting resin plastic pipe (RTRP) manufactured by the filament winding process. The casing pipe shall be wound to meet ASTM D2310 classification RTRP and ASTM D2996. The resin shall be a polyester isothalic resin. The outer surface shall be coated with a pigmented, protected resin containing a parafinated wax and ultraviolet inhibitors. Casing thickness shall be as follows:

Carrier Pipe Size		Casing Thickness	
(mm)	(Inches)	(mm)	(Inches)
50	2	5	0.185
80	3	5	0.185
100	4	5	0.185
150	6	6.5	0.250
200	8	6.5	0.250
250	10	6.5	0.250
300	12	6.5	0.250

2.2.4 Pipe Coupling, Steam

Coupling shall be of a multi-stage seal designed to accommodate the expansion and contraction of the system in the coupling. Couplings shall be of corrosion resistant materials capable of handling the design characteristics of the system listed in paragraph entitled "Rated Characteristics". The annular seals and carrier pipe ends shall be specifically designed to protect the seals and resist abrasion due to lateral loads in the system.

2.2.4.1 Pipe Coupling, Condensate

Coupling shall be a single stage seal design to accommodate the expansion and contraction of the adjacent pipes. Coupling shall be of corrosion resistance materials capable of handling the design characteristics of the system listed in paragraph entitled "Rated Characteristics". The annular seals and carrier pipe ends shall be specifically designed to protect the seals and resist abrasion due to lateral loads in the system.

2.2.5 Carrier Pipe Insulation

Conform to minimum thicknesses and type of insulation listed for WSL systems in Tables 1 and 2 as required for temperature in carrier pipe. Insulation shall consist of an inner layer of high temperature calcium silicate and an outer layer of polyurethane foam.

2.2.5.1 Calcium Silicate Insulation for Steam Systems

The calcium silicate insulation shall be a hydrous material satisfactory for temperatures to 650 degrees C. Calcium Silicate insulation shall conform to ASTM C-533. The physical properties shall be as follows:

Density (dry) 208 kg/cubic meter (minimum)
Compressive Strength to produce 5% compression: 1723 kPa (For 37 mm thick sample)

Maximum Linear shrinkage after 24 hour soaking period at 650 degrees C : 1.1%

Maximum Thermal Conductivity k k(metric) = W/(meter*K). . Where k varies with temperature as shown:

Mean Temp	100	200	300	400
k	0.38	0.41	0.44	0.48
k(metric)	0.04	0.04	0.04	0.04

2.2.5.2 Polyurethane Foam Insulation for Steam and Condensate Systems

Polyurethane foam shall be in accordance with ASTM C 591. The polyurethane foam shall completely fill the annular space between the calcium silicate insulation and the casing for the steam pipe and between the carrier pipe and the casing for condensate return system.

Polyurethane foam insulation shall also meet the following requirements:

a. Type: Two component urethane.

b. Compressive Strength: 172 kpu parallel to rise (minimum at 50% compression).

c. Shrinkage: None at 1 to 21 degrees C.

d. Free Rise Density: 32 kg/cubic meter.

e. Maximum aged k (32 degrees C /90% RH for 72 hours): .02 W/mK, at 24 degrees C, , when tested in accordance with ASTM C 518.

f. Minimum Closed Cell Content: 90%

2.2.5.3 Insulation Concentricity

Carrier pipe shall be concentric in relation to the casing pipe. The allowable maximum deviation from center line of the carrier pipe shall be plus or minus 6 mm at the casing center point and plus or minus 1.5 mm at the end seals.

2.2.5.4 Insulated Fittings

Fittings shall be pre-insulated by manufacturer using the same insulation thickness and casing as the straight sections.

2.2.5.5 Coupling Insulation for Steam Systems

The material which locks the bronze coupling in the casing shall be composed of refractory composite. The approximate minimum conductivity of this material shall be .2 W/(meter*K) at a mean temperature of 1260 degrees C.

2.2.5.6 Coupling Insulation for Condensate Systems

The coupling shall be insulated with polyurethane foam per requirements herein. The insulation thickness shall be equal to the carrier pipe insulation. The coupling shall be encased in the same casing as the pipe.

2.2.6 Manufacturer's Identification

Provide an embossed brass or stainless steel tag hung by a brass or stainless steel chain at each end of each casing or insulated piping in the manholes and buildings. The tags shall identify UHDS manufacturer's name and date of installation.

2.2.7 End Seals

2.2.7.1 General

Each preinsulated section of piping shall completely seal the insulation providing a permanent water and vapor seal at each end of the preinsulated section of piping. Preinsulated factory fabricated sections of piping modified in the field shall be provided with an end seal which is equivalent to the end seals furnished with the preinsulated section of piping. Tests shall be conducted by the UHDS manufacturer to demonstrate that casings, couplings and end seals are capable of resisting penetration of water into the casing and insulation under rated conditions. The tests shall be performed on each type of pre-fabricated system to be furnished, and the test results shall be verified by an independent testing laboratory. The steam system shall must be tested and certified in accordance with paragraph entitled Assembly Testing of WSL systems for Steam service.

2.2.7.2 End Seals for Steam Service

End seals shall be elastomer-ring type designed and dimensioned to fit in the annular space between the casing and the carrier pipe. Tape used for covering field repair joints shall be multi polymer alloy film type and shall be compatible with synthetic elastomeric tape, suitable for cold application.

2.2.7.3 End Seals for Condensate Return Service Types

End seals provided shall be one of the following types:

a. Carrying the outer casing over tapered pipe insulation ends and extending it to the carrier pipe. Sufficient surface bonding area shall be provided between the casing and the carrier pipe.

b. Using specially designed molded caps made of polyethylene or rubber of standard manufactured thickness. A minimum 40 mm surface bonding area shall be provided between the cap and both the casing and carrier pipe.

c. Using elastomer-ring end seals designed and dimensioned to fit in the annular space between the casing and the carrier pipe.

d. Using a waterproof mastic seal vapor barrier over the exposed insulation ends.

e. Shrink sleeves.

2.2.8 Assembly Testing of WSL Systems for Steam Service

The tests shall demonstrate that the WSL system will operate successfully for 25 years under typical operating conditions. The tests shall be conducted in both a dry and wet environment. The WSL system shall be as described in the manufacturer's brochure. The testing program described below shall be conducted at the expense of the WSL system manufacturer. Tests shall be witnessed and verified by an independent testing laboratory. The entire pre-insulated test section shall be hydrostatically tested, with water, to 2600 kPa (1/5 times the rated pressure) before and after temperature cycling. The tests shall be conducted in a dry environment for 60 cycles followed by a test in a wet environment for 60 cycles which demonstrates resistance to ground water infiltration. All tests shall be conducted on 1 test section and all testing shall be completed in 1 time period (approximately 6 weeks) and the 120 testing cycles shall be continuous except for weekend time periods.

2.2.8.1 Apparatus

A curved bottom test tank at least 3.7 m long, 0.8 m wide, 0.8 m deep shall be used. The tank shall be fitted with a gasketed and bolted cover to pressurize the tank to 60 kPa. The tank shall have a drain at the lowest point and a vent at the highest point. Manhole entrance sleeves (i.e. wall sleeves through the ends of the tank to simulate manhole entries in actual field conditions) shall be centrally located on each end of the tank. Auxiliary equipment shall include: Steam supply with sufficient capacity to satisfy testing requirements, makeup water tank and pump, and a means for continuously recording temperatures and pressures at needed locations. Thermocouples shall be used to record temperatures at the following points:

a. Carrier pipe at tank inlet (in thermowell).

b. Casing at mid-point in pipe length (on casing).

c. Casing at anchor point (above FRRP overwrap on plate).

d. Casing at field joint (repair, on casing).

e. Casing at coupling mid-point (on casing).

f. End seal flange at coupling (on elastomer).

g. Outer edge of new end plate (at steel plate and FRP wrap).

h. Carrier pipe at specimen outlet end (in thermowell).

i. Interface of calcium-silicate and polyurethane insulations.

j. Carrier pipe internal pressure, at inlet to test specimen.

Surface thermocouples shall be epoxied to the surface of the casing. The calibration of the thermocouples shall be checked and recorded prior to installation and the recorder shall record within 0.06 degrees C resolution. Pressure transmitter shall be used to record pressure in the test tank.

2.2.8.2 Test Section

A 100 mm steel carrier pipe test section consisting of 8 m of pre-insulated pipe meeting specified materials and design requirements shall be provided. Approximately 3.7 m of the test section shall be encased within the tank as described below. The test section within the tank shall consist of an expansion coupling, field repair joint, anchor plate, anchor block and end seals. The test section shall be installed (as directed) on at least 280 mm of firmly tamped sand. Sand shall not be any lower than 100 mm from the top of the tank. The test section shall be anchored to the tank wall at one end and the building floor at the other end on the portion of the pipe external to the tank. The expansion coupling shall be misaligned by 1.5 degrees in the horizontal plane. Sand (118 mL) shall be introduced into the carrier pipe and disbursed throughout the test loop at startup.

2.2.8.3 Resistance to Water Damage and Joint Leakage

This test shall simulate the operation of the WSL system to assure the system will provide successful service life through its expected life span. The system shall be tested in steam service by cycling for an extended period of time, as described below. System performance shall be deemed successful if there is no joint leakage, deformation of the casing, deterioration of the end seals, or any other deleterious effects.

a. The piping system shall be subjected to 60 cycles of admitting steam into the system while at an ambient temperature of less than 38 degrees C, up to a temperature of 207 degrees C (as measured at the core pipe at the tank inlet and tank outlet), stopping the steam admitted and allowing the system to cool back to ambient termperature. The system shall be held at 207 degrees C minimum for a minimum of 30 minutes, each cycle. This cycling shall continue for 60 cycles in dry sand followed by 60 cycles in a saturated environment. The reduction in temperature to less than 38 degrees C shall occur naturally with no artificial means of cooling used.

b. Results shall conform to paragraph Criteria for Satisfactory Results and Reporting.

2.2.8.4 Resistance to Mechanical or Structural Damage

This test shall simulate loads induced by truck traffic over pipe, which may occur under actual operating conditions. This test shall be conducted commencing with the 18th cycle of the Resistance to Water Damage and Joint Leakage test and continue through the 60th cycle. Other aspects of the Resistance to Water Damage and Joint Leakage test shall continue simultaneously with this test.

a. Apparatus: Same as for apparatus used in Resistance to Water Damage and Joint Leakage test, with the addition of a 96 kPa loading device. A hydraulic jack shall be used to apply the test pressure against a 500 x 500 mm plate bearing on the sand directly over the coupling in the tank.

b. Procedure: A steady and constant vertical load of 96 kPa shall be applied to the plate for 14 days during the test. The test section shall be installed as in the Resistance to Water Damage and Joint Leakage test. During the 14 day loading period, steam shall be circulated through the carrier pipe alternately at ambient and 207 degrees C as in earlier test.

c. Results: Requirements shall be in accordance with paragraph Criteria for Satisfactory Results and Reporting.

2.2.8.5 Resistance to Ground Water Infiltration

This test shall be the wet environment test conducted during the second 3 weeks (61st to 120th cycles) of the test period to show that the WSL system will resist the penetration of ground water into the system.

a. Apparatus: Same as for basic apparatus used in Resistance to Water Damage and Joint Leakage phase test, plus the following:

(1) One 200 L water reservoir with a 0 to 206 kPa pressure gauge and compressed air connection.

(2) Provisions to introduce pressurized red dye into the curved bottom test tank. The water/dye solution shall be mixed to a concentration in accordance with the dye manufacturer's recommendation for maximum detectability.

(3) One pressure tank with 0 to 206 kPa static pressure gauge.

b. Procedure: This phase shall start on the 61st cycle and continue until the 120th cycle. The test section of pipe shall be the same test segment used in the previous tests. The tank cover shall be bolted in place and the Resistance to Ground Water Infiltration test shall begin. The water/dye source shall be attached to the fill fitting and a surge tank shall be attached to the vent with a tee fitting. The pressure tank shall have a 0 to 206 kPa static pressure gauge attached. The other branch of the tee fitting shall employ a shut-off valve. With the shut-off valve open, the water/dye mixture shall be admitted into the tank through the fill fitting until the tank is full and water/dye runs freely from the open valve. The valve shall be closed and the filling shall continue until the pressure reaches 60 kPa . The tank pressure shall be maintained throughout the test period. Steam shall be circulated through the carrier pipe and cycled from ambient to 207 degrees C as in the previous test. At the end of the test, the pressure shall be relieved by opening the vent valve and the water/dye shall be drained from the tank through the drain fitting.

c. Results: Requirements shall be in accordance with paragraph criteria for Satisfactory Results and Reporting.

2.2.8.6 Criteria for Satisfactory Results and Reporting

a. Reporting: Logs of times and temperature shall be recorded to assure compliance with test requirements and procedures. Complete photographic documentation of the construction and operation of the test facility, as well as the piping system components before and after testing, shall be produced. Data shall be analyzed to assure complete compliance with test objectives.

b. Drawing: A drawing showing details of the test apparatus and test specimen shall be provided.

c. For the Resistance to Water Damage and Joint Leakage test: Joints and end seals shall be removed for examination, immediately upon completion of all test cycles. Successful results shall show that steam has not leaked out of the carrier pipe and that the components show no signs of deterioration.

d. For the Resistance to Mechanical or Structural Damage test: The loading shall not have been sufficient to cause the casing to be damaged or deformed enough to impair functioning of the system. The casing shall not be ruptured or deformed more than 25 mm in any direction. Casing sections with pipe anchors shall not fail.

e. For the Resistance to Ground Water Infiltration test: Determine whether or not the water/dye solution has entered the insulation.

This shall be observed by removing and inspecting all joints and seals for dye penetration at the end of the test. Results will be deemed successful if no dye solution is evident in the insulation.

f. Evidence of Test Results: After completion of all tests, the test apparatus shall be dismantled for visual inspection of all critical components subjected to the heat cycling, water infiltration and loading tests. All parts will be examined thoroughly for any detrimental affects. Examinations specified shall be conducted. Log sheets, test data and color photographs shall be kept on file and made available as required to document and substantiate compliance to the test requirements.

g. Report: A report from the independent testing agency shall be submitted. The report shall include the laboratory analysis of the condition of the test section and shall attest that the testing conditions were followed.

2.2.9 Assembly Test of WSL Systems for Condensate Return Service

Testing and certification procedures by an independent testing laboratory shall demonstrate that casings and end seals are capable of resisting penetration of ground water or condensate into the casing and insulation. The test shall be performed on the type of prefabricated system to be furnished. If more than 1 type of prefabricated system is to be used, the tests shall be performed on each type. The test shall consist of hot and cold cycle testing followed by immersion in a water filled chamber with a head pressure. The hot and cold cycle testing shall consist of a minimum of 120 cycles of temperature cycling. A fluid with a temperature of 5 degrees C shall circulate through the carrier pipe alternating every 3 hours with a fluid with a temperature of 121 degrees C circulating through the carrier. While the hot and cold cycle test is being performed, the test sample shall be either buried or encased in dry bedding sand with a minimum of 300 mm of sand all around the test sample. The carrier pipe size of the test sample shall be 75 mm in diameter and shall be restrained during the test period. The insulation thickness shall not exceed the maximum thickness provided for the piping in the project. Transition time for temperature cycle testing shall not exceed 15 minutes in going from cold to hot and 30 minutes from in going from hot to cold. The fluid in the carrier pipe shall be water, or steam. Following the hot and cold cycling test, the test sample shall be immersed in a water filled chamber. The pressure on the highest point of the test sample shall not be less than 60 kPa of water head pressure subjected over the entire length of the 2.4 m test sample of prefabricated pipe. The water shall contain a dye penetrant, which shall be used to check for end seal leakage. The pressure in the chamber shall be held for not less than 48 hours. Upon completion of this pressure test, the test sample shall be cut open. With the use of a light that will readily show the presence of the dye that was in the water, the test sample shall be inspected. Evidence of the dye inside the test sample shall indicate that the end seal is not acceptable and cannot be certified.

2.3 PIPE INSULATION TYPE AND MINIMUM THICKNESS FOR DIRECT BURIED HEAT DISTRIBUTION SYSTEMS

Materials containing asbestos are not permitted.

2.3.1 Insulation Thickness

The minimum thickness of insulation for the heat distribution system shall be in accordance with Tables 1 and 2 in which the insulations listed have passed the 96 hour boiling water test.

TABLE 1
MINIMUM PIPE INSULATION THICKNESS (mm)

For Steam (100 to 2.800 kPa (gage)) and High Temperature Hot Water Supply and Return (120 to 230 degrees C).

	INSULATIONS For Drainable/Dryable Systems			INSULATIONS For other Pre-Engineered Systems	
Nominal Pipe Diameter (mm)	Paroc	Epitherm Delta	Kaylo-10 Thermo-12 Super Caltemp	Calcium Silicate	WSL Polyurethane
25	50	63	100	N/A	N/A
40	50	63	100	N/A	N/A
50	63	85	110	N/A	N/A
65	63	85	110	N/A	N/A
80	75	100	125	25	+31
100	75	100	125	25	+31
125	75	100	125	N/A	N/A
150	85	110	135	35	+34
200	85	110	135	50	+30
250	100	125	150	63	+33
300	100	125	150	50	+32
350	100	125	150	N/A	N/A
400	100	125	150	N/A	N/A
450	100	125	150	N/A	N/A

TABLE 2
MINIMUM PIPE INSULATION THICKNESS (mm)
CONDENSATE RETURN
HIGH TEMPERATURE HOT WATER RETURN SYSTEM

Nominal Pipe Diameter (mm)	Paroc	Epitherm	Kaylo-10 Thermo-12 Super Caltemp	Polyurethane
25	35	50	75	N/A
40	35	50	75	N/A
50	35	50	75	19
65	35	50	75	N/A
80	50	63	85	26
100	50	63	85	26
125	50	63	85	N/A
150	63	76	110	30
200	63	76	110	N/A
250	76	100	125	N/A
300	76	100	125	N/A
350	76	100	125	N/A
400	76	100	125	N/A
450	76	100	125	N/A

2.4 HEAT DISTRIBUTION PIPING

2.4.1 Steam Pipe

Pipe material shall be steel; seamless, ASTM A53, Grade B or ASTM A106, Grade B; or electric resistance welded ASTM A53, Grade B; Schedule 40. Standard weight permitted for pipe sizes 300 mm and above. ASTM A53, Type F furnace butt welded pipe is not allowed. No joints shall be allowed in the factory fabricated straight section of the carrier pipe. Factory fabricated piping sections as part of an expansion loop or bend shall have all welded joints 100% radiographed inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing (ASNT) Level III radiographer, employed by the testing firm, who shall sign the reading report.

2.4.1.1 Condensate Pipe

Steel; seamless, ASTM A53, Grade B or ASTM A106, Grade B, schedule 80; electric resistance welded ASTM A53, Grade B; Schedule 80. ASTM A53, Type F furnace butt welded pipe is not allowed. No joints shall be allowed in the factory fabricated straight section of the carrier pipe. Factory fabricated piping sections as part of an expansion loop or bend shall have all welded joints 100% radiographed inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by an ASNT Certified Level II radiographer, employed by the testing firm, who shall sign the reading report.

2.4.1.2 Joints

Joints shall be butt-weld except socket-weld joints are permitted for pipe sizes 50 mm and smaller. Dye penetrant inspection may be used in place of 100% radiographic inspection for pipe sizes 50 mm and below. Indicate location and elevation of all field joints on detailed design layout drawings. Split-ring welding rings may be used.

2.4.2 Fittings

All welds in factory fittings shall be 100% radiographic inspected. All radiographs shall be reviewed and interpreted by a Certified ASNT Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer reserves the right to review all inspection records, and if any welds inspected are found unacceptable in accordance with ASME B31.1, the fitting shall be removed, replaced, and radiographically reexamined at no cost to the government.

2.4.2.1 Butt-Welded

Steel, ASTM A234, Grade B, ANSI B16.9, same schedule as adjoining pipe. All elbows shall be long radius unless otherwise indicated. Tees shall be full size or reducing as required, having interior surfaces smoothly contoured. Split-ring welding rings may be used.

2.4.2.2 Socket-Welded

Forged steel, ASME B16.11, 13,800 kPa class will be used for pipe sizes 50 mm and below. Dye penetrant inspection may be used in place of 100% radiographic inspection of welded fittings for pipe sizes 50 mm and below.

2.5 EXPANSION LOOPS AND BENDS

Stresses shall be less than the maximum allowable stress from the Power Piping Code (ASME B31.1). Submit detailed design layout drawings and stress and anchor force calculations for all loops and bends. Show locations of all anchors, guides and supports. Base the calculations on rated characteristics (pressures and temperatures), specified herein, for both the supply and return lines.

2.6 Cathodic Protection System

Cathodic protection system shall be provided in accordance with the provisions indicated in Section 13114,"Design/Build Cathodic Protection Systems".

PART 3 EXECUTION

3.1 GENERAL

3.1.1 UHDS Design

The UHDS manufacturer is responsible for the complete design of the UHDS, the product to be supplied, fabrication, witnessing installation and testing of the system within the design parameters established by the contract drawings and specifications and in compliance with the detailed design. The complete design of the UHDS shall be prepared, signed, and sealed by a Professional Engineer in the employ of the UHDS manufacturer.

3.1.2 Installation, Inspection, and Testing

The pre-engineered system shall be installed, inspected, and tested in accordance with the contract drawings and specifications, the UHDS manufacturer's standard procedures, detailed design layout drawings and any directions given by the UHDS manufacturer's representative. All work described in paragraph "UHDS Manufacturer's Representative's Responsibilities" shall be performed in the presence of the UHDS manufacturer's representative.

3.1.3 Job Conditions

Phasing of demolition and construction shall be in accordance with the provisions of Section 01011, "General Requirements", and as shown on contract drawings.

3.1.4 Interruption of Existing Service

The contractor shall arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to assure adequate heat distribution service for existing installations at all times. Only such absolutely necessary interruptions as may be required for making connections shall be permitted, and only at such times when approval is obtained from the Contracting Officer. Interruptions to heat distribution service shall be only with prior approval, and be the minimum possible duration. All interruptions shall be as approved by the Contracting Officer.

3.1.5 Connecting to Existing Work

Connect new work to existing work in a neat and workmanlike manner.

Connection shall be made only in manholes. Where an existing structure must be cut or existing utilities interfere, such obstruction shall be bypassed, removed, replaced or relocated, restored and repaired. Any changes required to the UHDS design as a result of interferences or conflicts must be approve by the UHDS designer and the Contracting Officer. Work disturbed or damaged shall be replaced to its prior condition, as required by section, "General Requirements".

3.1.6 Coordination

Coordinate the location of all items of equipment and work of all trades. Maintain operability and maintainability of the equipment and systems. Any relocation of equipment or systems to comply with the requirement of operability and maintainability shall be performed by the contractor at his cost.

3.1.7 Grading

Unless otherwise shown on the contract drawings or the detailed design layout drawings, steam/condensate and high temperature hot water supply/return lines shall be graded uniformly downward not less than 40 mm in 10 meters to the lower point of entry between manholes and/or building entries.

3.1.8 Variations

Any variations from the approved detailed design layout drawings must be submitted to the Contracting Officer for approval. Variations must be signed and sealed by the UHDS manufacturers' professional engineer responsible for the complete design of the UHDS.

3.1.9 Storage and Handling

Equipment and material placed on the job shall remain in the custody of the Contractor until final acceptance whether or not the Contractor has been reimbursed for the equipment and material by the Government.

The Contractor is solely responsible for the protection of the equipment and material against damage from any source. Protect all materials against entry of water and mud by installing watertight protection on open ends at all times. Sections of the casing or carrier piping found to have been subjected to full or partial submergence in water (which would allow the insulation to become wet) shall be immediately replaced. Protect materials at all times while stored or during installation from damage from UV light. Materials awaiting installation shall be completely covered to protect from UV degradation.

Place all damaged items in new operating condition or replace damaged items as determined and directed by the Contracting Officer, at no additional cost to the Government.

3.2 DEMOLITION

Perform work in accordance with requirements for phasing. Completely remove all pipe, valves, fittings, insulation, and all hangers including the connection to the structure and any fastenings. Seal all openings in manhole or building walls after removal of piping. All material and equipment removed shall become the property of the Contractor and shall be removed from Government property within one week and shall not be stored in operating areas. All flame cutting shall be performed with adequate fire protection facilities available as required by safety codes and Contracting Officer.

3.2.1 Asbestos Removal

Conform to Section 13281, "Engineering Control of Asbestos Containing Materials".

3.3 PIPE, PIPING JOINTS AND FITTINGS

3.3.1 Welded Joints

Clean pipe and fittings inside and outside before and after assembly. Remove all dirt, scale, and other foreign matter from inside the piping by use of a pipe swab or pipe pig before connecting pipe sections, valves, equipment or fittings. Use eccentric connectors as necessary between casing sections to provide drainage of casing section between manholes and between manholes and buildings.

3.3.2 Fittings

All changes in direction shall be made with factory-built reinforced fittings. Field-fabricated fittings and miters are not permitted.

3.4 WELDING

The Contractor is entirely responsible for the quality of the welding and shall:

a. Conduct tests of the welding procedures used by his organization, determine the suitability of the procedures used, determine that the welds made shall meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.

b. Comply with ASME B31.1.

c. Perform all welding operations required for construction and installation of the heat distribution system.

3.4.1 Qualification of Welders

Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1 and also as outlined below.

3.4.2 Examining Welders

The contractor shall examine each welder to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall:

a. Weld only in positions in which he/she has qualified.

b. Identify welds with the specific code marking signifying name and number assigned.

3.4.3 Examination Results

Provide the Contracting Officer with a list of names and corresponding code markings. Retest welders which fail to meet the prescribed welding qualifications. Disqualify welders who fail the second test, for work on the project.

3.4.4 Beveling

Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

3.4.5 Alignment

Utilize split welding rings for field joints on all carrier pipes above 50 mm to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Make field joints 50 mm and smaller with welding sockets.

3.4.6 Erection

Piping shall not be split, bent, flattened, or otherwise damaged either before, during, or after installation. Where the pipe temperature falls to 0 degrees C or lower, the pipe shall be heated to approximately 38 degrees C for a distance of 300 mm on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C.

3.4.7 Defective Welds

Replace and reinspect defective welds in accordance with ASME B31.1. Repairing defective welds by adding weld material over the defect or by peening shall not be permitted. Welders responsible for defective welds must be requalified.

3.4.8 Electrodes

Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

3.4.9 Radiographic Testing

An approved independent testing firm regularly engaged in radiographic testing shall perform radiographic examination of 100% of the field welds in the carrier piping of direct-buried systems in accordance with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to installing casing field joints, backfilling and hydrostatic testing. All radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer reserves the right to review all inspection records, and if any welds inspected are found unacceptable they shall be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.5 HEAT DISTRIBUTION SYSTEM INSTALLATION

The UHDS manufacturer's representative shall oversee the delivery, storage, and witness the installation and testing of the system. All work shall be in strict accordance with the requirements specified herein and with the printed instructions of the manufacturer. These specifications shall take precedence over the printed instructions, if conflicts arise. Printed instructions shall be submitted to the Contracting Officer prior to system installation.

3.5.1 Verification of Final Elevations

Prior to covering the top of the casing with backfill material, but after all temporary supports have been removed and initial backfilling of the conduit system has been accomplished, the Contractor shall measure and record the elevation of the top of the casing in the trench. Elevations shall be taken at every completed field joint, 1/3 points along each pipe section and top of elbows. This measurement shall be checked against the contract drawings. These measurements shall confirm that the conduit system has been installed to the elevations shown on the contract drawings. Slope shall be uniform to within 0.1%. These measurements shall be recorded by the Contractor, included in the UHDS manufacturer's representative daily report, and given to the Contracting Officer prior to covering the casing with backfill material.

3.5.2 Excavation, Trenching, and Backfilling

Perform all excavation, trenching, and backfilling as required by the UHDS manufacturer's design and as specified in Section 02302, "Excavation, Backfilling, and Compacting for Utilities". Pipe shall lay on a 305 mm minimum sand bed and backfilled with sand on all sides to a minimum of 150 mm as measured from outside of casing. Foundation for system must be firm and stable. Foundation and backfill must be free from rocks or substances which could damage the system coating. Concrete anchor and thrust blocks must be installed in undisturbed earth. Backfilling must not commence until system has been satisfactorily pressure tested (both hydrostatic test of carrier and, for DDT system, pneumatic test of casing. Minimum depth of burial to the top of the casing is 1 meter. Maximum depth of burial to the top of the casing is 3 meters.

3.5.3 UHDS Manufacturer's Representative Responsibilities

This shall be a person who regularly performs the duties listed below, is certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified herein. The UHDS Manufacturer's representative shall be present at the job site and witness when the following types of work are being performed:

a. Inspection and unloading.

b. Inspection of trench prior to commencing installation of system.

c. Inspection of concrete anchors and thrust blocks.

d. Hydrostatic testing of carrier piping.

e. Field joint closure work.

f. Pneumatic testing of DDT system casing.

g. Holiday test of conduit coating.

h. Repair of any coating.

i. Installation of cathodic protection system, per Section 13114, "Design/Build Cathodic Protection System".

j. Initial backfill up to 250 mm above the top of the casing.

k. Verification of final elevations. Elevation readings shall be witnessed and recorded.

l. Testing of cathodic protection system, per Section 13114, "Design/Build Cathodic Protection System".

m. Operational tests

The UHDS manufacturer's representative is to notify the contractor immediately of any problems. If necessary, the UHDS manufacturer's representative will notify the Contracting Officer of problems requiring immediate action, otherwise the daily reports will note any problems encountered and indicate the corrective actions taken.

3.5.4 UHDS Manufacturer Representative's Reports

The UHDS manufacturer representative shall prepare and sign a written daily report. Present the original daily report to the Contracting Officer no later than one working day after it is prepared, and forward one copy to the manufacturer's main office. The report shall state whether or not the condition and quality of the materials used and the delivery, storage, installation and testing of the system are in accordance with the plans, specifications, and manufacturer's printed instructions and is satisfactory in all respects. When any work connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the UHDS manufacturer's recommendations for corrective action. The report shall identify any conditions that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper manhole entries. The daily reports are to be reviewed, signed and sealed, on a weekly basis, by the registered engineer responsible for the system design. Signed and sealed copies of the daily reports shall be submitted with the payment request. Requests for payment shall be denied if the weekly review is not accomplished.

Upon completion of the work and before final acceptance, deliver to the Contracting Officer a notarized Certificate of Compliance signed by a principal officer of both the manufacturing and the contracting firm, stating that the installation is satisfactory and in accordance with plans, specifications, and manufacturer's instructions.

The UHDS manufacturer will retain a copy of all daily reports and the Certificate of Compliance for 5 years after final acceptance of the system by the government.

3.5.5 Protection

Protect casing coating from damage during unloading, storage, rigging and installation. Protect casing and carrier pipe ends from water intrusion during unloading, storage, rigging and installation. Protect piping and all accessories from damage due to exposure to UV light.

3.5.6 Defective Material

The UHDS Manufacturer's Representative shall take prompt action to remove from the site all damaged or defective material, subject to rejection in accordance with the quality assurance provisions included in the manufacturer's submittals and printed instructions, and shall order prompt replacement of such material.

3.5.7 Cathodic Protection

Provide cathodic protection for all steel casing systems and all buried exposed metal. Assume that 25% of the exterior of the UHDS is exposed metal. Cathodic protection systems shall have a minimum design life of 25 years and shall conform to Section 13114, "Design/Build Cathodic Protection System". Provide dielectric pipe flanges and unions and isolation devices at all points necessary. Provide test stations at grade on each section of the piping system. Isolation flanges and unions shall be rated for the service temperature and pressure.

3.6 TESTS

Demonstrate leak-tightness of all piping systems by performing pressure tests (hydrostatic, pneumatic) and operational tests. Pressure test heat distribution system in conformance with requirements stated in this specification and in printed instructions for the system supplied. Tests shall include carrier piping and casing. The carrier pipe shall be hydrostatically tested. Casings of DDT systems shall be pneumatically tested.

3.6.1 Holiday Testing of Direct-Buried System Steel Casings

Test entire exterior surface of the casing including the bottom exterior surface of the casing for faults in coating after installation in trench prior to backfilling. Use test method and voltage recommended by coating manufacturer. Repair any holidays found and retest. System shall not be backfilled until all holidays are eliminated.

3.6.2 Pneumatic, Hydrostatic and Operational Tests

Before conducting heat distribution system tests, flush lines with high pressure water until discharge shows no foreign matter and are deemed clean to the satisfaction of the Contracting Officer.

3.6.2.1 Pneumatic Test

The casing of DDT systems shall be pneumatically tested after welding and before field coating using air as the test medium. The test pressure shall be 103 kPa. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the casing has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship T(1)P(2)=T(2)P(1), in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial (1) and final (2) readings. Pressure shall be measured with a mercury manometer, inclined manometer(slope gauge), or an equivalent device so calibrated as to be read in increments of not greater than 1 kPa. Pressure shall be measured with a pressure gauge conforming to ASME B40.1. A throttling type needle valve or a pulsation dampener and shutoff valve may be included. The diameter of the face shall be at least 114 mm with a measurable range of 0 to 103 kPa and graduations of not greater than 0.5 kPa. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested while under test pressure by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain proper safety precautions for air pressure testing at all times during the tests.

3.6.2.2 Hydrostatic Test

Carrier piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1.5 times the heat distribution supply pressure for 2 hours. There shall be no indication of reduction of pressure during the test. Pressure shall be measured with a device calibrated as to be read in increments of not greater than 35 kPa.

3.6.2.3 Operational Test

Prior to acceptance of the installation, Contractor shall subject system to operating tests simulating actual operating conditions to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than six hours for each portion of system tested. Conduct tests at times as the Contracting Officer may direct.

a. The contractor shall provide calibrated instruments, equipment, facilities and labor, at no additional cost to the Government.

b. When failures occur, repair problems then repeat test.

3.6.3 Deficiencies

Deficiencies discovered shall be corrected at the Contractor's expense, to the satisfaction of the Contracting Officer. Major deficiencies or failure to correct deficiencies, to the satisfaction of the Contracting Officer, may be considered cause for rejecting the entire installation.

3.7 VALVE MANHOLES

Valve manholes, piping, and equipment in valve manholes shall be in accordance with the contract drawings and Section 02559, "Valve Manholes, Piping and Equipment in Valve Manholes".

3.8 BURIED UTILITY WARNING AND IDENTIFICATION

3.8.1 Plastic Marking Tape

Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines shall be supplied and installed. Tape shall be buried above the pipe during the trench backfilling operation and shall be buried approximately 300 mm below grade. Tape shall be 0.1 mm thick polyethylene. Tape shall be acid and alkali-resistant and shall have a minimum strength of 12 MPa lengthwise and 10.3 MPa crosswise with an elongation factor of 350 percent. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 1 m deep. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. The tape shall be of a type specifically manufactured for marking and locating metallic underground utilities. Tape shall be 150 mm wide and printed with a caution and identification of the piping system over the entire tape length. Tape shall be yellow with bold black letters. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

3.8.2 Markers for Underground Piping

Markers for underground piping shall be located along the distribution and service lines. Markers shall be placed as indicated approximately 600 mm to the right of the distribution system when facing in direction of flow in the supply line. The marker shall be concrete 150 mm square or round section 900 mm long. The top edge of the marker shall have a minimum 13 mm chamfer all around. The letters [STEAM] [HTHW] [CONDENSATE] shall be impressed or cast on the top, and on one side of the markers to indicate the type of system that is being identified. Each letter shall be formed with a V-shaped groove and shall have a width of stroke at least 6 mm at the top and depth of 6 mm. The top of the marker shall protrude not more than 50 mm above finished grade.

3.9 THERMAL PERFORMANCE TESTING

The purpose of this section is to provide a basis for assuring the thermal performance of a heat distribution system procured under this specification. The equipment and procedures specified herein shall assure acceptable thermal performance upon installation. All materials and procedures described for this test shall be included as deliverables of the construction contract for the system unless otherwise noted. The methods used from the prescribed thermal performance measurements have been verified by several successful field studies. This work has clearly demonstrated that methods based on temperature measurements at the soil/casing interface are accurate, reliable, and repeatable.

3.9.1 Equipment

3.9.1.1 Casing Temperature Measurement

Before backfilling, temperature sensors shall be installed by adhesion with epoxy (epoxy used to adhere to exterior of casing shall be suitable to 260 degrees C) to the exterior of every other field closure after welding, once the field coating has been applied and cured. A sensor shall be adhered with epoxy to the coated casing at the midpoint of every other pipe section between field joints, but no closer than 1.5 m to any guide on the interior of the casing. After the sensors have been adhered to the casing, two complete wraps of duct tape shall be used to secure and protect the sensor. In all cases the radial position of the sensor shall be at 45 degrees from the top of the conduit at either the 1:30 or 10:30 position. The position chosen shall be the position facing away from the adjacent heat distribution system pipe, if present. All sensors shall be type T thermocouples in accordance with ANSI MC96.1, copper constantan 20 gauge thermocouples, made from special limits grade thermocouple wire (accuracy plus or minus 0.40 degrees C), with each conductor insulated and an overall jacket on all conductors. Insulation on the thermocouple wires shall be suitable for service at temperature of carrier pipe. No splicing or other connections will be allowed in the thermocouple wire between sensor location and termination point. Each sensor shall be shown with a special symbol on the detailed design layout drawings and shall be identified by a number and/or letter code, starting from the upstream manhole.

3.9.1.2 Carrier Pipe Temperature Measurement

Carrier pipe temperature shall be measured within the manhole where the terminal equipment will be located. Carrier pipe temperature shall be measured by a sensor adhered with epoxy, suitable to 260 degrees C, directly to the exterior of the carrier pipe. Sensors shall be type T thermocouples in accordance with ANSI MC96.1, copper constantan 20 gauge thermocouples, made from special limits grade thermocouple wire (accuracy plus or minus 0.40 degrees C), with each conductor insulated and an overall jacket on all conductors. Insulation on the thermocouple wires shall be suitable for service at temperature of carrier pipe. No splicing or other connections will be allowed in the thermocouple wire between sensor location and termination point. The location of this sensor shall be at either the 1:30 or 10:30 position. At the location of the sensor the carrier pipe shall be insulated with an approved calcium silicate insulation of 125 mm minimum thickness. This insulation shall extend at least 150 mm on each side of the actual sensor location and shall be clad with an aluminum jacket.

3.9.1.3 Terminals

The wires from each casing or carrier pipe temperature sensor shall be extended into the nearest manhole and terminated in a NEMA Type 4 waterproof enclosure, of suitable size, mounted near the top of the manhole at a location near the manhole entrance so as to be accessible without entrance into the manhole, where possible. The termination of the sensor wires shall be with a connector type OMEGA Miniature Jack Panel (MJP-*-*-T) or exact equal. The thermocouple jack panel shall be mounted to the back plate of the NEMA Type 4 enclosure. The temperature sensors shall be labeled at their termination within the NEMA Type 4 enclosure; a drawing showing the location of each temperature sensor shall be laminated and attached to the inside of the NEMA Type 4 enclosure. the manufacturer's operating casing temperature factors for each temperature sensor location shall be laminated to a card attached to the inside of the NEMA Type 4 enclosure. All temperature sensors shall be verified as operational by an independent laboratory, hired by the Contractor, after backfilling is complete but before the system is accepted.

3.9.2 Initial Thermal Performance Test

After the system construction is complete, including all backfilling, and the system has reached operating condition for not less than 48 hours nor more than 168 hours, all of the temperature sensors shall be read by an independent laboratory with experience and equipment appropriate for the sensors used. For each temperature sensor location the initial casing temperature shall be recorded. All of the temperature values of the temperature sensors shall be tabulated and submitted in accordance with requirements herein.

3.9.3 Warranty Thermal Performance Test

After not less than 9 months nor more than 11 months of continuous operation, all of the temperature values of the temperature sensors shall be read by an independent laboratory with experience and equipment appropriate for the sensors used. The temperature shall be tabulated and submitted in accordance with requirements herein.

3.9.4 System Failure

System shall be deemed a failure when the conduit surface temperature exceeds values in Table 3, that portion shall be repaired and temperatures again measured and recorded.

TABLE 3

Carrier Pipe Temperat. TP (degrees C)	Carrier Pipe Temperat. TP (degrees F)	Acceptable Casing Temperature TC (degrees C)	Acceptable Casing Temperature TC (degrees F)
121	250	43	110
135	275	47	116
149	300	50	123
163	325	54	129
177	350	58	136
204	400	65	149
218	425	68	155
232	450	72	162

The following equations were used to calculate the above values:

TC <=[(0.261) X (TP) + 44.3] (for English units)
TC <=[(0.261) X (TP) + 11.5] (for Metric units)

-- End of Section --

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SECTION 02554

EXTERIOR ABOVEGROUND STEAM DISTRIBUTION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME/ANSI B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME/ANSI B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995; Addenda 1995 and 1996) Power Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1995) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193/A 193M	(1996; Rev. B) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 475	(1995) Zinc-Coated Steel Wire Strand
ASTM D 229	(1996) Rigid Sheet and Plate Materials Used for Electrical Insulation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGSINDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

1.2 SYSTEM DESCRIPTION

Provide new and modify existing exterior aboveground steam and condensate piping system complete and ready for operation. Provide piping to and including the main steam pressure regulating valves, bypass valves, safety-relief valves, and high pressure traps. Design pressure and temperature ratings of system components shall be for working pressure of 1723 kPa (gage) steam."

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Piping

b. Valves

c. Strainers

d. Pipe hangers and supports

e. Traps

f. Gages

g. Steam flow meters

1.3.2 SD-08 Statements

a. Certification of welder's qualifications

1.3.2.1 Certification of Welder's Qualifications

Submit prior to site welding. Certifications shall not be more than one year old.

1.3.3 SD-19 Operation and Maintenance Manuals

a. Manhole drainers, Data Package 2

b. Steam flow meters, Data Package 2

Submit in accordance with Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 PIPING

Steam piping includes piping upstream of steam traps. Condensate piping includes piping downstream of steam traps.

2.1.1 Steam Pipe

a. ASTM A 53, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B); black steel. Provide Weight STD (Standard) for welding end connections. Provide Weight Class XS (Extra Strong) for threaded end connections.

b. ASTM A 106, Grade A or B, black steel, Schedule No. 40 for pipe sizes through 250 mm, and minimum pipe wall thickness of 9.50 mm for pipe sizes 300 mm and larger for welding end connections. Provide Schedule 80 for threaded end connections.

2.1.2 Condensate Pipe

Provide steel piping.

a. ASTM A 53, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B); black steel, Weight Class XS (Extra Strong).

b. ASTM A 106, Grade A or B, black steel, Schedule No. 80.

2.1.3 Buried Steel Piping to Cooling Well or Drain

Provide direct buried steel condensate pipe and fittings with exterior coal tar epoxy painting system.

2.2 FITTINGS

2.2.1 Threaded Fittings

ASME B16.11, or ANSI/ASME B16.3, Class 300 for steam, Class 300 for condensate.

2.2.2 Socket Welding Fittings

ASME B16.11.

2.2.3 Buttwelding Fittings

ASME/ANSI B16.9. Provide the same material and weight as the piping in which fittings are installed. Backing rings shall conform to ASME B31.1 and be compatible with materials being welded.

2.2.4 Eccentric Reducing Fittings

ASME/ANSI B16.9. Provide the same material and weight as the piping in which fittings are installed. Provide for changes in horizontal steam piping sizes.

2.2.5 Flanges and Unions

2.2.5.1 Flanges

ASME/ANSI B16.5, Class 150 or 300 as required.

2.2.5.2 Unions

ASME/ANSI B16.39, Class 300 for steam, Class 250 for condensate.

2.2.6 Gaskets, Bolts, Nuts, and Washers

a. Gaskets: ASME B16.21, composition ring 1.60 mm thick. Provide one piece factory cut ring gaskets for raised-face flanged joints, and full-face gaskets for flat-face flanged joints.

b. Bolts: ASTM A 193/A 193M, Grade B7. Extend a minimum of two full threads beyond the nut with the bolts tightened to the required torque.

c. Nuts: ASTM A 194/A 194M, Grade 7, with Teflon coated threads.

d. Washers: Provide steel flat circular washers under bolt heads and nuts.

e. Electrically isolating (insulating) gaskets for flanges: Provide ASTM D 229 electrical insulating material of 1000 ohms minimum resistance. Provide one piece factory cut insulating gaskets between flanges. Provide silicon-coated fiberglass insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3.20 mm thick high-strength insulating washers next to flanges and provide stainless steel flat circular washers over insulating washers and under bolt heads and nuts. Provide bolts 13 mm longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts in the horizontal position or not greater than 45 degrees above the horizontal position.

2.3 VALVES

Provide with stems in the horizontal position or not greater than 45 degrees above the horizontal position. Valves shall have flanged end connections, except sizes smaller than 65 mm may have union end connections, or threaded end connections with a union on one side of the valve.

2.3.1 Valves for Steam Service

Valves upstream of steam traps shall be steel body for minimum working pressure of ASME Class 300.

2.3.1.1 Gate Valves, Globe Valves, Angle Valves, and Check Valves

ASME/ANSI B16.34, steel body, minimum of ASME Class 300. Provide swing check valves.

2.3.1.2 Steam Pressure Regulating Valves

Steel body, minimum of ASME Class 300, except as modified herein. Valve seats and disc shall be of replaceable heat-treated stainless steel. Valves shall be single seated, seat tight under dead end conditions, and move to the closed position in the event of pressure failure of the operating (controlling) medium. Provide strainer in inlet from external operating (controlling) medium. Valves shall be controlled by pilot valve with strainer at inlet from external pressure sensing piping. Valves shall be internally or externally steam traced for freeze protection. Valves shall be piston operated type or spring loaded diaphragm operated type with stainless steel springs.

2.3.1.3 Safety-Relief Valves

Minimum of ASME Class 300, with test lever. Valves shall have steel or copper alloy body. Valves shall have flanged inlet and outlet connections or threaded connections attached to threaded ASME Class 300 flanges. Valves shall be ASME rated for capacity indicated.

2.3.2 Valves for Condensate Service

Valves downstream of steam traps shall be for minimum working pressures of ASME Class 125.

2.3.2.1 Gate Valves

MSS SP-80, except sizes 65 mm and larger shall conform to MSS SP-70.

2.3.2.2 Globe and Angle Valves

MSS SP-80, except sizes 65 mm and larger shall conform to MSS SP-85.

2.3.2.3 Check Valves

MSS SP-80, except sizes 65 mm and larger shall conform to MSS SP-71. Provide swing check valves.

2.4 PIPING ACCESSORIES

2.4.1 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 43, of the adjustable type, except as specified or indicated otherwise. Tack-weld Type 39 pipe covering protection saddles to steel pipe for insulated piping. Provide steel support rods. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dip galvanized after fabrication. Rollers, bases, and saddles may be painted with two coats of aluminum or light gray paint rated for use on hot metal surfaces up to 232 degrees C in lieu of hot-dip galvanized. Provide stainless steel axles for rollers. Miscellaneous metal shall conform to ASTM A 36/A 36M, hot-dip galvanized after fabrication.

2.4.2 Strainers

Construct of steel in accordance with ASME/ANSI B16.5 for minimum of ASME Class 300. Provide stainless steel strainer element with perforations of 0.40 mm for steam, 0.80 mm for steam mixed with condensate, and 1.20 mm for condensate (hot water). Provide blow-off outlet with pipe nipple, gate valve, and discharge pipe nipple.

2.4.3 Traps

Steel body, internals of stainless steel, minimum of ASME Class 300, and of the types indicated.

2.4.4 Gages

Provide single style pressure gage for steam with 115 mm dial, brass or aluminum case, bronze tube, gage cock, pressure snubbers, and syphon. Provide scale range for the intended service.

2.4.5 Pipe Sleeves

Provide where piping passes entirely through walls and floors. Provide sleeves of sufficient length to pass through entire thickness of walls and floors. Provide 25 mm minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

a. Sleeves in Masonry and Concrete Walls and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of sleeves when cavities in the core-drilled hole are grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls and Floors: Provide 26 gage galvanized steel sheet.

2.4.6 Escutcheon Plates

Provide split hinge type metal plates for piping entering walls and floors in exposed spaces. Provide polished stainless steel plates or chromium-plated copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.4.7 Steam Flow Meters

Meter shall be for minimum working pressure of ASME Class 300 with steel pressure chambers. Provide meter in horizontal pipe between two ASME/ANSI B16.5 welding neck flanges. Provide rotary type meter for flow integration. Working parts shall be stainless steel. Steam flow shall cause rotation of a rotor assembly at a speed directly proportional to the rate of steam flow, as controlled by a damping liquid. The rotational speed of the rotor assembly shall be reduced by gearing in the damping liquid chamber. Final drive to the exterior counter shall be by driving magnets; stuffing box shall not be allowed. Counter shall be enclosed in a dust-tight cast-aluminum housing attached to, but easily removable from the meter. For steam pipe main sizes 100 mm and smaller, provide meter directly in the steam piping. For steam pipe main sizes larger than 100 mm, provide meter in shunt bypass piping with two ASME/ANSI B16.5 Class 300 welding neck orifice flanges in the steam pipe main. In the shunt bypass piping, provide two flanged gate valves calibrated by the meter manufacturer. In the steam pipe main, provide 3.20 mm thick stainless steel orifice plate sized to suit meter capacity between two ASME/ANSI B16.5 Class 300 welding neck orifice flanges. Provide six-dial counter with an electrical contactor to transmit signal to data terminal cabinet (DTC) for indicating steam flow in kg.

2.4.8 Flexible Ball Expansion Joints

Provide chromium plated steel balls capable of 360-degree rotation plus 15-degree angular flex movement. Provide pressure molded composition gaskets designed for continuous operation temperature of 274 degrees C. Joints shall be for minimum working pressure of ASME Class 300. Provide flanged or buttwelding end connections as indicated.

2.5 POLES SUPPORTING ABOVEGROUND PIPING

2.5.1 Concrete Poles

Provide under this section as specified in Section 02588, "Concrete Poles." Accurately set the top fittings to grade by means of adjusting screws, and grout in place. Provide high-strength grout consisting of one part portland cement and two parts clean, sharp sand with minimal water to make a workable grout. Wet tops of poles before placing the grout. Prevent grout leaks around the bottom of the fittings which streak or disfigure the concrete. Discoloration or disfiguring of concrete will not be permitted.

2.5.2 Guy Wires, Fittings, and Hardware

a. Guy Wires: ASTM A 475, high strength grade, extra galvanized, stranded with seven wires in each strand. Wire shall be a minimum of 9.5 mm diameter. Provide thimbles at each end of guy wire. Prestress guy wires until taut.

b. Anchor Rods and Anchors: Provide thimble-eye, 32 mm diameter steel rod with 250 mm diameter screw anchor, hot-dip galvanized.

c. Turnbuckles: Provide open turnbuckles, forged steel body, with jaw and jaw end pulls, 9.50 mm size, hot-dip galvanized.

d. Clamps: Provide hot-dip galvanized forged high carbon steel clamps capable of developing full strength of guy wire, and fitted with galvanized heat-treated bolts. Provide two clamps at each connection of guy wire.

2.5.3 Miscellaneous Metal

ASTM A 36/A 36M, standard mill finished structural shapes, hot-dip galvanized after fabrication.

2.5.4 Fastenings

Provide steel bolts and oversized nuts conforming to ASTM A 307. Galvanize in accordance with ASTM A 153/A 153M. Provide nuts with an approved means for locking to ensure nuts remain tight under severe service, including vibrations. Drive bolts to a tight fit without injury to the threads. Bolts with injured threads will not be permitted. Drill holes 1.60 mm larger than bolts; burning of holes will not be permitted. Tighten bolts to the required torque.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of exterior steam distribution system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, except as modified herein. Install piping straight and true to bear evenly on supports and sand bedding material. Install valves with stems horizontal or above. Provide flanges or unions at valves, traps, strainers, connections to equipment, and as indicated.

3.1.1 Cleaning of Piping

Keep the interior and ends of new piping and existing piping affected by the Contractor's operations, cleaned of water and foreign matter during installation by using plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.1.2 Demolition

Remove materials so as not to damage materials which are to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Reducing branch connections in steel piping may be made with forged branch outlet reducing fittings for branches two or more pipe sizes smaller than mains. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Stab type connections will not be permitted. Jointing compound for pipe threads shall be Teflon pipe thread paste. Pipe nipples 150 mm long and shorter shall be Schedule 80 steel pipe. Make changes in piping sizes through tapered reducing fittings; bushings will not be permitted. Condensate piping shall include drip, vent, relief, and gage connecting piping.

3.2.1 Fittings and End Connections

For sizes less than one inch provide threaded fittings and end connections. For sizes 25 to 50 mm provide threaded or socket-welding or buttwelding fittings and end connections; provide threaded connections for threaded valves, traps, strainers, and threaded connections to equipment. For sizes 65 mm and larger provide buttwelding fittings and end connections; provide flanged connections for flanged valves, traps, strainers, and flanged connections to equipment.

3.2.2 Welding

ASME B31.1, metallic arc process, including qualification of welders.

3.2.3 Pipe Hangers and Supports

Provide additional hangers and supports for concentrated loads in piping between hangers and supports, such as for valves. Support steel piping as follows:

MAXIMUM SPACING (METER)

Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Steel Piping	2.70	3.70	4.00	4.60	5.20	6.40	7.30	8.00	9.20

3.2.4 Buried Piping Under Roads

Installation including field joints, bedding, and initial backfill shall be in accordance with the Approved Brochure.

3.3 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Nameplates shall be melamine plastic, 3.20 mm thick, black with white center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be minimum of 6.40 mm high normal block style. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass, and locate where directed near each system. Furnish two copies of each chart and schedule.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.4.2 Piping Tests

Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements. Before insulation is applied, hydrostatically test each piping system at not less than 1551 kPa (gage) in accordance with ASME B31.1, with no leakage or reduction in gage pressure for 2 hours. Flush and clean piping before placing in operation. Flush piping at a minimum velocity of 2.40 meters per second. Correct defects in work provided by Contractor and repeat tests until work is in compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for the tests.

3.5 FIELD PAINTING

After completion of field inspections and tests, clean and paint metal surfaces exposed to the weather and in manholes, including valves, strainers, traps, flow meters, pipe flanges, bolts, nuts, washers, pipe hangers, supports, expansion joints, and miscellaneous metal. Do not paint piping prior to the application of field-applied insulation. Do not paint stainless steel or aluminum jackets. Apply paint to clean dry surfaces. Clean surfaces to remove dust, dirt, rust, oil, and grease. Provide surfaces with two coats of enamel paint applied to a total minimum dry film thickness of 0.05 mm. Apply the second coat of paint after the preceding coat is thoroughly dry. Color of finish coat shall be aluminum or light gray. Paint shall be rated for use on hot metal surfaces up to 232 degrees C and for use on surfaces exposed to the weather.

3.6 CONNECTIONS TO EXISTING SYSTEMS

Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required. Obtain approval before interrupting service. Provide materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required.

-- End of Section --

SECTION 02588

CONCRETE POLES
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 318M	(1995) Building Code Requirements for Structural Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1995; Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 416/A 416M	(1996) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 421	(1991) Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. B) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 33	(1993) Concrete Aggregates
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral

	Admixture in Concrete
ASTM C 989	(1995) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and Prestressed Concrete

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-05 Design Data

a. Concrete mix design

1.2.1.1 Design Requirement

At least 30 calendar days prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolan, ground slag, and admixtures; and applicable reference specification. Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and is suitable for the job conditions. Furnish fly ash and pozzolan test results performed within 6 months of submittal date. Obtain approval before concrete placement. An identical concrete mix design previously approved within the past 12 months by the Atlantic Division, Naval Facilities Engineering Command, may be used without further approval, if copies of the previous approval and fly ash and pozzolan test results are submitted. Obtain acknowledgement of receipt of test results prior to concrete placement. Submit additional data regarding concrete aggregates if the source of aggregate changes.

1.2.2 SD-08 Statements

a. Quality control procedures

1.2.2.1 Procedure Requirement

Submit the precasting manufacturer's quality control proceduresestablished in accordance with PCI MNL-116.

1.3 QUALITY ASSURANCE

1.3.1 Concrete Poles

Provide precast concrete poles or precast prestressed poles for use in overhead steam distribution systems. Precast prestressed concrete poles or precast concrete poles shall be the product of a manufacturer specializing in the production of precast concrete members. Prestressed concrete poles shall be designed in accordance with PCI MNL-120 or precast concrete poles shall be designed with section properties equivalent to those of the prestressed concrete poles. Produce poles in one piece, and in accordance with PCI MNL-116.

1.3.2 Modification of References

In the ACI publications, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Interpret references to the "building official," "Structural Engineer," and "Architect/Engineer" to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 CONCRETE

ACI 211.1 or ACI 318M for Contractor furnished mix design. The minimum compressive strength of concrete at 28 days shall be 35 MPa, unless otherwise indicated. Add air-entraining admixtures to produce between 4 and 6 percent air by volume.

2.2 CEMENT

ASTM C 150, Type I, II, or III, or ASTM C 595M, Type IP or IS blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast-furnace slag. The pozzolan or fly ash content shall not exceed 25 percent by weight of the total cementitious material and the ground iron blast-furnace slag shall not exceed 50 percent by weight of total cementitious material.

2.2.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Types N and F.

2.2.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.3 WATER

Provide fresh, clean and potable water.

2.4 AGGREGATES

ASTM C 33, Size 57, 67, or 7. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.5 ADMIXTURES

ASTM C 494, except that air entraining shall conform to ASTM C 260.

2.6 REINFORCEMENT

2.6.1 Reinforcing Bars

ASTM A 615/A 615M, Grade 400, ASTM A 617/A 617M Grade 400; ASTM A 616/A 616M Grade 400; or ASTM A 706/A 706M.

2.6.2 Ties and Spirals

Steel, ASTM A 82.

2.6.3 Prestressing Steel

Seven-wire stress-relieved strand conforming to ASTM A 416/A 416Mor stress-relieved wire conforming to ASTM A 421, Type WA. The minimum ultimate strength shall be 1750 MPa. Prestressing steel shall be free from grease, oil, wax, paint, soil, dirt, loose rust, kinks, bends, or other defects.

PART 3 EXECUTION

3.1 PREPARATION

Prior to installation of poles, check for damage, such as cracking, spalling, and honeycombing. Reject members which contain honeycombed sections deep enough to expose reinforcing steel. Reject structurally impaired prestressed members. Provide a PCI MNL-116 commercial grade finish.

3.2 INSTALLATION

3.2.1 Pole Placement

3.2.1.1 Augering

Poles shall be set in augered holes with a diameter as indicated. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 20 MPa at 28 days and finish in a dome. Cure concrete a minimum of 72 hours before performing further work on poles.

3.3 EXCAVATING, BACKFILLING, AND COMPACTING

Provide as specified in Section 02315, "Excavation and Fill."

3.4 PROTECTION OF POLES

Take care to avoid damage to poles during handling.

-- End of Section --

SECTION 02630

STORM DRAINAGE
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M252	(1994) Corrugated Polyethylene Drainage Tubing
AASHTO M294	(1994) Corrugated Polyethylene Pipe, 305 to 915 mm (12 to 36 in.) Diameter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM A 497	(1995) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM C 32	(1993) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 62	(1997) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 139	(1997) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 443M	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 476	(1995) Grout for Masonry
ASTM C 478M	(1996; Rev. A) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 564	(1995; Rev. A) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 923M	(1996) Resilient Connectors Between Reinforced Concrete Manhole Structures,

	Pipes and Laterals (Metric)
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2564	(1996; Rev. A) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2680	(1995; Rev. A) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 3034	(1996) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996; Rev. A) Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
ASTM D 4101	(1996; Rev. A) Propylene Plastic Injection and Extrusion Materials
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1996; Rev. A) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 949	(1996; Rev. A) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1996) Structural Welding Code Steel

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27	Fixed Ladders

1.2 SUBMITTALS

Submit the following in accordance with Section 02001, "Division 02 Submittal Reduction Procedures."

1.2.1 SD-02 Manufacturer's Catalog Data

a. Cast-iron soil piping including fittings and jointing materials

b. Composite plastic piping including fittings and jointing materials

c. Polyvinyl chloride (PVC) plastic piping including fittings and jointing materials

d. Corrugated high density polyethylene piping including fittings and jointing materials

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

1.3.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.3.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.3.1.3 Cement, Aggregates, and Reinforcement

Store as specified in Section 03300, "Cast-in-place Concrete."

1.3.2 Handling

Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Carry, do not drag pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Soil Pipe and Fittings

ASTM A 74, service-weight.

2.1.1.2 Jointing Materials for Cast-Iron Soil Piping

Gaskets shall be compression-type rubber gaskets conforming to ASTM C 564.

2.1.2 Composite Plastic Piping

2.1.2.1 ABS Composite Plastic Pipe and Fittings

Acrylonitrile-Butadiene Styrene (ABS) or Poly(Vinyl Chloride) (PVC) composite pipe and fittings, ASTM D 2680.

2.1.2.2 Jointing Materials for ABS Composite Plastic Piping

ASTM D 2680 solvent cement and primer or ASTM D 3212 elastomeric gasket joints. Ends of pipe and fittings shall be suitable for either Type SC or Type OR joints.

2.1.3 Polyvinyl Chloride (PVC) Plastic Piping

2.1.3.1 PVC Plastic Pipe and Fittings

ASTM D 3034, shall be SDR 35, having ends adaptable for elastomeric gasket joints.

2.1.3.2 Joints and Jointing Material for PVC Plastic Piping

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

Polyvinyl Chloride (PVC) Pipe and Fittings, 250 mm Diameter and Smaller: ASTM D 3034, SDR 35, with ends suitable for elastomeric gasket joints. ASTM F 949 with solvent cement joints or elastomeric gasket joints. ASTM D 3212 elastomeric gasket joints, ASTM D 2564 solvent cement joints and ASTM F 477 gaskets.

2.1.4 Corrugated High Density Polyethylene Piping

2.1.4.1 Pipe and Fittings

Corrugated, high density polyethylene pipe (HDPE) conforming to AASHTO M252 or AASHTO M294.

2.1.4.2 Joints and Jointing Materials

Manufacturer's recommendations for HDPE joint].

2.2 CONCRETE MATERIALS

Provide as specified in Section 03300, "Cast-In-Place Concrete"

2.3 MISCELLANEOUS MATERIALS

2.3.1 Drainage Structures

Construct of clay brick, solid concrete masonry units or concrete, except that airfield catch basins, headwalls, gutters, top of curb inlets, and bases shall be concrete. Precast structures may be provided in lieu of cast-in-place concrete except for airfield catch basins, headwalls, and gutters. Pipe-to-wall connections shall be mortared to produce smooth transitions and watertight joints or provided with ASTM C 923M resilient connectors. Bases shall have smooth inverts accurately shaped to a semicircular bottom conforming to the inside contour of the adjacent sewer sections. Changes in direction of the sewer and entering branches into the manhole shall have a circular curve in the manhole invert of as large a radius as the size of the manhole will permit.

2.3.1.1 Precast Concrete Structures

ASTM C 478M, except as specified herein. Provide [an air content of 6 percent, plus or minus 2 percent and] a minimum wall thickness of 125 mm. ASTM A 615/A 615M reinforcing bars. ASTM A 497 welded wire fabric. ASTM C 443M or AASHTO M198, Type B gaskets for joint connections. Provide a 100 mm layer of clean gravel bedding with a maximum size of 50 mm.

2.3.2 Masonry Materials

Shall conform to the following specifications and other requirements specified hereunder.

2.3.2.1 Brick

ASTM C 32, Grade MS, or ASTM C 62, Grade SW, except that the absorption test will be waived.

2.3.2.2 Concrete Masonry Units

ASTM C 139.

2.3.2.3 Mortar

ASTM C 270, Type M.

2.3.2.4 Water

Water for masonry mortar shall be fresh, clean, potable.

2.3.2.5 Grout

ASTM C 476.

2.3.3 Metal Items

2.3.3.1 Frames, Covers, and Gratings

Shall be cast iron conforming to CID A-A-60005, figure numbers as follows. Fabricate frames, covers, and gratings for airfield use of standard commercial grade steel, welded by qualified welders in accordance with AWS D1.1. Covers shall be of rolled steel floor plate having an approved anti-slip surface. Steel gratings shall be of commercial grade steel and be of welded construction.

a. Traffic manhole: Provide in paved areas.

   Frame: Figure 1, Size 22A
   Cover: Figure 8, Size 22A
   Steps: Figure 19

b. Non-traffic manhole:

   Frame: Figure 4, Size 22
   Cover: Figure 12, Size 22
   Steps: Figure 19

2.3.3.2 Drainage Structure Steps

Zinc-coated steel as indicated conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443M, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes or catch basins less than 1.2 mdeep.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to pipeline installation except where specific exception is made under paragraph entitled "Special Requirements."

3.1.1.1 Earthwork

Perform earthwork operations in accordance with Section [02315, "Excavation and Fill."

3.1.1.2 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; remove those found defective from site and replace with new. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell ends in the upgrade direction. Adjust spigots in bells to produce a uniform space. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper calking or installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 7.5 m apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.1.3 Connections to Existing Lines

Notify Contracting Officer in writing at least 10 days prior to date that connections are to be made. Obtain approval of the Contracting Officer before interrupting service. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast-Iron Soil Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for joints with this piping; assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of ABS or PVC Composite Plastic Piping

Install pipe and fittings in accordance with the "General Requirements for Installation of Pipelines" and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint; assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.3 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with the "General Requirements for Installation of Pipelines" and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping; assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.4 Installation of Corrugated High Density Polyethylene Piping

Install pipe and fittings in accordance with the "General Requirement for Installation of Pipelines" and with the recommendations of the HDPE pipe manufacturer.

3.1.3 Concrete Work

Perform cast-in-place concrete work in accordance with Section 03300, "Cast-In-Place."

3.1.4 Manhole and Catch Basin Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent drainage sections. For changes in direction of drains and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. For precast concrete construction, make joints between sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Give a smooth finish to inside joints of precast concrete manholes and catch basins. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the paragraph entitled, "Concrete Work." Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose or mortared to produce a watertight joint; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as required to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding beyond into the manhole.

3.1.5 Metal Work

3.1.5.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide rabbets, lugs, and brackets wherever necessary for fitting and support.

3.1.5.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing . Be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications.

3.2.2 Pipeline Testing

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests. Prior to testing for leakage, backfill trench up to at least the lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When the water table is 600 mm or more above top of pipe at upper end of pipeline section to be tested, measure infiltration using a suitable weir or other acceptable device. When the water table is less than 600 mm above top of pipe at upper end of pipeline section to be tested, make exfiltration test by filling the line to be tested with water so that the head will be at least 1.2 m above top of pipe at upper end of pipeline section being tested. Allow filled pipeline to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, re-establish the head and measure amount of water needed to maintain this water level during a 2 hour test period. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed 47 liters per millimeter of diameter per day per kilometer of pipeline. When leakage exceeds the amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

-- End of Section --

SECTION 02741

BITUMINOUS CONCRETE PAVEMENT
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1188	(1996) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2726	(1996; Rev. A) Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952	(Rev. D) Paint, Traffic and Airfield Marking, Waterborne

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(1994) Road and Bridge Specifications

1.2 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.2.1 SD-05, Design Data

a. Job-mix formula

1.2.1.1 Job-Mix Formula

Submit the mix design, including mixing temperature, for approval. The mix design shall include a certified laboratory analysis of mix composition with marshall stability value, void content, and flow. After mix design approval, job mixes shall conform to the range of tolerances specified in VDOT RBS. An identical mix design previously approved within the past 12 months by the Atlantic Division, Naval Facilities Engineering Command, may be used without further approval, provided that copies of the previous approval are submitted. Obtain acknowledgement of receipt prior to bituminous concrete placement. Submit additional data regarding materials if the source of the materials changes.

1.2.2 SD-13, Certificates

a. Stone base course

b. Paint

1.3 QUALITY ASSURANCE

1.3.1 Modification to References

Except as specified herein or as indicated, work and materials shall be in accordance with the VDOT RBS. The provisions therein for method of measurement and payment do not apply, and references to "Engineer" and "State" shall be interpreted to mean the "Contracting Officer" and the "Federal Government" respectively.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not produce or place bituminous concrete when the weather is rainy or foggy, when the base course is frozen or has excess moisture, or when the ambient temperature is less than 4.4 degrees Celsius in the shade away from artificial heat.

1.5 BARRICADES AND SIGNALS

Provide and maintain temporary signs, signals, lighting devices, markings, barricades, and channelizing and hand signaling devices to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Concrete Mix

VDOT RBS, Section 211, Type SM-2A for material and mix. Provide crushed stone aggregates for the bituminous mix.

2.1.1.1 Recycled Asphalt Material

Bituminous concrete mix may contain a maximum of 25 percent by weight of the total aggregate material, reclaimed asphalt pavement (RAP). Mix design shall meet the requirements for the type of bituminous concrete specified. Clearly state the viscosity of reclaimed asphalt cement, grade of new asphalt cement, properties of recycling agent if used, and percentage of each in the mix. Combine asphalts and recycling agents to achieve a viscosity of 200 plus or minus 40 pascal-second at 60 degrees Celsius. Furnish a new job mix formula for each change in percentage of RAP material used.

2.1.2 Stone Base Course

VDOT RBS, Section 208, Type 1, Size No. 20, 21, 21A or 21B.

2.1.3 Bituminous Tack Coat

VDOT RBS, Section 310. Emulsified asphalts shall be diluted at the rate of one part water to one part asphalt.

2.1.4 Paint

FS TT-P-1952, white, unless indicated otherwise.

2.2 MIX PLANT

VDOT RBS, Section 211.11.

PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION

Provide a stone base course, and a bituminous concrete surface course. Subgrade preparation shall be as specified in Section 02315, "Excavation and Fill."

3.1.1 Stone Base Course Placement

Begin spreading base material at the point nearest the source of supply. Permit traffic and hauling over the base. Fill ruts formed by traffic and reroll. After base course placement, continue machining and rolling until surface is smooth, compacted, well bonded, and true to the designed cross section. Compact to 100 percent ASTM D 698 maximum dry density. Maintain the base smooth and true to grade and cross section until bituminous concrete placement.

3.1.2 Bituminous Tack Coat Placement

Provide tack coat on existing pavement to be overlaid at the rate of 0.453 liters residual asphalt per square meter. Thoroughly clean surfaces to receive the tack coat immediately prior to application of tack coat. Tack coat shall be tacky at the time of bituminous concrete placement.

3.1.3 Bituminous Concrete Application

3.1.3.1 Placing Temperature

Minimum temperature of bituminous concrete during placement into mechanical spreader shall be 107 degrees Celsius. Mixtures which have a lower temperature shall be rejected.

3.1.3.2 Joints

Where new pavement abuts existing bituminous pavement, cut existing surface course along straight lines approximately 150 mm from edge. Cuts shall be vertical and extend the full depth of the surface course. Prior to bituminous concrete placement, apply asphalt cement to exposed edges of cold joints.

3.1.3.3 Spreading and Finishing Equipment

Spread the bituminous concrete to a uniform density and produce a smooth finish, true to cross section and free from irregularities. Provide adjustable screeds to shape the surface to true cross section.

3.1.3.4 Bituminous Concrete Placement

As continuous as possible. Place in maximum 50 mm lifts. Avoid passing rollers over unprotected edges of bituminous concrete prior to bituminous concrete cooling. If rollers pass over unprotected edges of bituminous concrete prior to cooling, cut bituminous concrete back to expose full depth of bituminous concrete. Immediately prior to resumption of bituminous concrete placement, coat exposed edges of bituminous concrete with asphalt cement. When bituminous concrete placement resumes, rake the hot bituminous concrete against asphalt cement and compact.

3.1.3.5 Featheredges

Accomplish featheredging by raking out the larger aggregate as necessary and sloping the pavement uniformly throughout the featheredge to create a smooth transition. Unless indicated otherwise, featheredge transition shall be 3.05 m.

3.1.3.6 Compaction

VDOT RBS for equipment and compaction procedures, modified to compact bituminous concrete to 96 percent of maximum laboratory density. Finished surface shall be uniform in texture and appearance and free of cracks and creases.

3.1.3.7 Protection

No vehicular traffic shall be allowed on pavement for a minimum of 6 hours after final rolling, or until bituminous concrete has cured, whichever is longer.

3.2 PAVEMENT MARKINGS

Unless indicated otherwise, provide painted lines 100 mm in width. Apply paint after bituminous concrete has cured for a minimum of 7 days, and minimum ambient temperature is 4.4 degrees Celsius. Apply paint to clean, dry surfaces, and protect surfaces from traffic until dry. Provide uniform paint film of sufficient thickness to completely conceal pavement.

3.3 FIELD QUALITY CONTROL

3.3.1 Sampling

Provide new materials where samples are taken. Take the number and size of samples required to perform the following tests.

3.3.1.1 Bituminous Concrete Sampling

a. Job Mix: Take one initial sample and one sample for every 362,840 kilograms or fraction thereof.

b. Thickness: Take one sample for every 418 square meter or fraction thereof.

c. Density: One field test for every 836 square meter or fraction thereof, and one laboratory test for the project. Provide minimum 100 mm diameter cores if nuclear testing is not used.

3.3.1.2 Stone Base Course Sampling

a. Thickness: Take one sample for every 418 square meters or fraction thereof.

b. Density: One field test for every 836 square meters or fraction thereof, and one laboratory test for the project.

3.3.2 Testing

Provide for each sample.

3.3.2.1 Bituminous Concrete Testing

a. Job Mix: Determine gradation and bitumen content.

b. Thickness: Maximum allowable deficiency shall be 6 mm less than the indicated thickness. Average thickness shall be as indicated.

c. Density, In Place: ASTM D 2922 and ASTM D 3017; cored sample ASTM D 1188 or ASTM D 2726.

3.3.2.2 Stone Base Course Testing

a. Thickness: Maximum allowable deficiency shall be 13 mm less than the indicated thickness. Average thickness shall be as indicated.

b. Density: ASTM D 1556 or ASTM D 2922 and ASTM D 3017.

-- End of Section --

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SECTION 02752

PORTLAND CEMENT CONCRETE PAVEMENT
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1996) Structural Concrete for Buildings
ACI 305R	(1991) Hot Weather Concreting
ACI 306.1	(1990) Cold Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 143	(1997) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997; Rev. A) Portland Cement
ASTM C 171	(1997) Sheet Materials for Curing Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 98	(1995) Calcium Chloride

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952	(Rev. D) Paint, Traffic and Airfield Marking, Waterborne

1.2 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Curing materials

b. Admixtures

Submit a complete list of materials including type, brand, source for cement, fly ash, pozzolan, admixtures, and applicable reference specifications.

1.2.2 SD-05, Design Data

a. Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete.

1.2.3 SD-10, Test Reports

a. Fly ash tests

b. Pozzolan tests

c. Concrete mix design test

1.2.3.1 Required Information

Submit results of fly ash and pozzolan testing and show that the concrete mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement. An identical concrete mix design previously approved within the past 12 months by the Atlantic Division, Naval Facilities Engineering Command, may be used without further approval, provided that copies of the previous approval and fly ash and pozzolan test results performed within 6 months of submittal date are submitted. Obtain acknowledgement of receipt prior to concrete placement. Submit a new mix design data regarding concrete aggregates, when the source of aggregate changes.

1.2.4 SD-12, Field Test Reports

a. Compressive strength tests

1.2.5 SD-13, Certificates

a. Paint

1.3 DELIVERY, STORAGE, AND HANDLING

ASTM C 94.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

ASTM C 150, Type I or II.

2.1.2 Water

Fresh, clean, and potable.

2.1.3 Aggregates

Free from any substance which may be deleteriously reactive with the alkalies in the cement.

2.1.3.1 Fine Aggregates

ASTM C 33.

2.1.3.2 Coarse Aggregates

ASTM C 33, Size No. 467.

2.1.4 Admixtures

Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer.

2.1.4.1 Air-Entraining

ASTM C 260.

2.1.4.2 Retarding

ASTM C 494, Type B or D.

2.1.4.3 Accelerating

ASTM D 98.

2.1.4.4 Water Reducing

ASTM C 494, Type A, D, E, F, or G.

2.1.4.5 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Types C and F.

2.1.4.6 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 120.

2.1.5 Forms

Wood, plywood, steel, or other suitable material.

2.1.6 Reinforcement

Provide as specified in Section 02762. "Joints and Reinforcement in Concrete Pavements".

2.1.7 Curing Materials

2.1.7.1 Impervious Sheeting

ASTM C 171 with a minimum sheet thickness of 0.25 mm.

2.1.7.2 Liquid Membrane-Forming Compound

ASTM C 309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.8 Joint Fillers and Sealants

Provide as specified in Section 02762, "Joints and Reinforcement in Concrete Pavements."

2.1.9 Paint

FS TT-P-1952, white, unless indicated otherwise on drawings.

2.2 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318M except as otherwise specified. The compressive strength (f'c) of the concrete for each portion of the structure(s) shall be as indicated and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (MPa)	ASTM C 33 Aggregate (Size No.)	Range of Slump (mm)	Water-Cement Ratio (by weight)	Air Entr. (percent)
Pavement	30	57	25-75	0.45	5-7

Maximum slump shown above may be increased 25 mm for methods of consolidation other than vibration. Slump may be increased to 175 mm when superplasticizers are used. Provide air entrainment using air-entraining admixture. Air entrainment shall be within plus or minus 1.5 percent of the valve specified. The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days shall not exceed 0.30.

2.2.1 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as follows:

For f'c between 20 and 35 MPa, 8 MPa plus f'c.

PART 3 EXECUTION

3.1 FORMS

3.1.1 Construction

Construct forms to be removeable without damaging the concrete.

3.1.2 Coating

Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer.

3.1.3 Grade and Alignment

Check and correct grade elevations and alignment of the forms immediately before placing the concrete.

3.2 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.2.1 Measuring

ASTM C 94.

3.2.2 Mixing

ASTM C 94, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 29.4 degrees C, reduce mixing time and place concrete within 60 minutes. Additional water may be added to bring slump within required limits as specified in Section 11.7 of ASTM C 94, provided that the specified water-cement ratio is not exceeded.

3.2.3 Conveying

ASTM C 94.

3.2.4 Placing

ACI 301, except as modified herein. Do not exceed a free vertical drop of 0.90 m from the point of discharge.

3.2.5 Vibration

Immediately after spreading concrete, consolidate concrete with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs 150 mm or more in thickness. Limit duration of vibration to that necessary to produce consolidation of concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in concrete at one location for more than 15 seconds. At the option of the Contractor, vibrating equipment of a type approved by the Contracting Officer may be used to compact concrete in unreinforced pavement slabs less than 150 mm thick.

3.2.5.1 Vibrating Equipment

Operate equipment, except hand-manipulated equipment, ahead of the finishing machine. Select the number of vibrating units and power of each unit to properly consolidate the concrete. Mount units on a frame that is capable of vertical movement and, when necessary, radial movement, so vibrators may be operated at any desired depth within the slab or be completely withdrawn from the concrete. Clear distance between frame-mounted vibrating units that have spuds that extend into the slab at intervals across the paving lane shall not exceed 750 mm. Distance between end of vibrating tube and side form shall not exceed 50 mm. For pavements less than 250 mm thick, operate vibrators at mid-depth parallel with or at a slight angle to the subbase. For thicker pavements, angle vibrators toward the vertical, with vibrator tip preferably about 50 mm from subbase, and top of vibrator a few mm below pavement surface. Vibrators may be pneumatic, gas driven, or electric, and shall be operated at frequencies within the concrete of not less than 8,000 vibrations per minute. Amplitude of vibration shall be such that noticeable vibrations occur at 450 mm radius when the vibrator is inserted in the concrete to the depth specified.

3.2.6 Cold Weather

Except with authorization, do not place concrete when ambient temperature is below 5 degrees C or when concrete is likely to be subjected to freezing temperatures within 24 hours. When authorized, when concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that temperature of concrete when deposited is between 18 and 27 degrees C. Methods of heating materials are subject to approval of the Contracting Officer. Do not heat mixing water above 74 degrees C. Remove lumps of frozen material and ice from aggregates before placing aggregates in mixer. When specifically approved by the Contracting Officer, the Contractor may add not more than 2 percent dihydrate calcium chloride by weight of cement. Dissolve admixture in a portion of the mixing water and add to the mix at the drum in a manner that will ensure uniform distribution of the agent throughout the batch. Follow practices found in ACI 306.1.

3.2.7 Hot Weather

Maintain required concrete temperature in accordance with Figure 2.1.5 in ACI 305R to prevent evaporation rate from exceeding 0.98 kg of water per square meter of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. After placement, use fog spray, spread and remove polyethylene sheeting between finishing operations, apply monomolecular film, or use other suitable means to reduce the evaporation rate. Start curing when surface of fresh concrete is sufficiently hard to permit curing without damage. Cool underlying material by sprinkling lightly with water before placing concrete. Follow practices found in ACI 305R.

3.3 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Use finishing machine, except hand finishing may be used in emergencies and for concrete slabs in inaccessible locations or of such shapes or sizes that machine finishing is impracticable. Finish pavement surface on both sides of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hard finishing equipment for use at all times. Transverse and longitudinal surface tolerances shall be 6 mm in 3 m.

3.3.1 Side Form Finishing

Strike off and screed concrete to the required slope and cross-section by a power-driven transverse finishing machine. Transverse rotating tube or pipe shall not be permitted unless approved by the Contracting Officer. Elevation of concrete shall be such that, when consolidated and finished, pavement surface will be adequately consolidated and at the required grade. Equip finishing machine with two screeds which are readily and accurately adjustable for changes in pavement slope and compensation for wear and other causes. Make as many passes over each area of pavement and at such intervals as necessary to give proper compaction, retention of coarse aggregate near the finished surface, and a surface of uniform texture, true to grade and slope. Do not permit excessive operation over an area, which will result in an excess of mortar and water being brought to the surface.

3.3.1.1 Equipment Operation

Maintain the travel of machine on the forms without lifting, wobbling, or other variation of the machine which tend to affect the precision of concrete finish. Keep the tops of the forms clean by a device attached to the machine. During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length.

3.3.1.2 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of edge rounding, in excess of 6 mm. Finish concrete surface on each side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

3.3.1.3 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished pavement surface is at the indicated elevation. Vibrate entire surface until required compaction and reduction of surface voids is secured with a strike-off template.

3.3.1.4 Longitudinal Floating

After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats. Use floats that are not less than 3.65 m long and 150 mm wide and stiffened to prevent flexing and warping.

3.3.2 Surface Finish

3.3.2.1 Brooming

Finish the surface of the slab by brooming the surface with a new wire broom at least 450 mm wide. Gently pull the broom over the surface of the pavement from edge to edge just before the concrete becomes non-plastic. Slightly overlap adjacent strokes of the broom. Broom perpendicular to centerline of pavement so that corrugations produced will be uniform in character and width, and not more than in depth. Broomed surface shall be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface.

3.3.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of 3 mm. When brooming is specified for the final surface finish, edge transverse joints before starting brooming, then operate broom to obliterate as much as possible the mark left by the edging tool without disturbing the rounded corner left by the edger. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Remaining edges shall be smooth and true to line.

3.3.4 Repair of Surface Defects

ACI 301.

3.4 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use impervious-sheeting curing, or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded. Maintain temperature of air next to concrete above 5 degrees C for the full curing periods.

3.4.1 Impervious-Sheeting Curing

Wet entire exposed surface thoroughly with a fine spray of water and then cover with impervious sheeting. Lay sheets directly on concrete surface and overlap 300 mm. Make sheeting not less than 450 mm wider than concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets when torn or otherwise damaged during curing. Leave sheeting on concrete surface to be cured for at least 7 days.

3.4.2 Liquid Membrane-Forming Compound Curing

Seal or cover joint openings prior to application of curing compound to prevent curing compound from entering joint. Compound shall remain on concrete for 7 days before removing sealer or covering, and placing joint sealing material in joints.

3.4.2.1 Application

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Total coverage for the two coats shall be at least 4 liters of undiluted compound per 20 square meters. Compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

3.4.2.2 Protection of Treated Surfaces

Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

3.5 PAVEMENT MARKINGS

Unless indicated otherwise, provide painted lines 100 mm in width. Apply paint after concrete has cured for a minimum of 7 days, and minimum ambient temperature is 4.4 degrees Celsius. Apply paint to clean, dry surfaces, and protect surfaces from traffic until dry. Provide uniform paint film of sufficient thickness to completely conceal pavement.

3.6 FIELD QUALITY CONTROL

3.6.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.6.2 Testing

3.6.2.1 Slump Tests

ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 8 cubic meters (maximum) of concrete.

3.6.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 10 degrees C and above 27 degrees C) for each batch (minimum) or every 8 cubic meters (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.6.2.3 Compressive Strength Tests

ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 120 cubic meters of concrete, nor less than once for each 500 square meters of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 3 MPa, take a minimum of three ASTM C 42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.6.2.4 Air Content

ASTM C 173 or ASTM C 231 for normal weight concrete . Test air-entrained concrete for air content at the same frequency as specified for slump tests.

-- End of Section --

SECTION 02762

JOINTS AND REINFORCEMENT IN CONCRETE PAVEMENTS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615/A 615M	(1995; Rev. C) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 603	(1990) Extrusion Rate and Application Life of Elastomeric Sealants
ASTM C 639	(1995) Rheological (Flow) Properties of Elastomeric Sealants
ASTM C 661	(1993) Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
ASTM C 679	(1987; R 1992) Tack-Free Time of Elastomeric Sealants
ASTM C 719	(1993) Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
ASTM C 792	(1993) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C 793	(1991) Effects of Accelerated Weathering on Elastomeric Joint Sealants
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2628	(1991) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 1993) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200	(Rev. E; Am. 2) Sealants, Joint, Two-Component, Jet-Blast Resistant, Cold-Applied, For Portland Cement Concrete Pavement
FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-04 Drawings

a. Preformed Compression seals

Manufacturer's catalog data in the form of catalog cuts may be submitted in lieu of drawings for the listed items.

1.2.2 SD-06 Instructions

a. Joint sealants

b. Preformed compression seals

Instructions for joint sealants shall include, but not be limited to: storage requirements, ambient temperature and humidity ranges, and moisture condition of joints for successful installation; requirements for preparation of joints; safe heating temperature; mixing instructions; installation equipment and procedures; application and disposal requirements; compatibility of sealant with filler material; curing requirements; and restrictions to be adhered to in order to reduce hazards to personnel or to the environment. Submit instructions at least 30 days prior to use.

1.2.3 SD-08 Statements

a. Equipment list

Submit a list and description of equipment to be used. Equipment for heating, mixing and installing joint seals shall be in accordance with instructions provided by joint seal manufacturer.

1.2.4 SD-11 Factory Test Reports

a. Joint sealer

1.2.5 SD-18 Records

a. Joint sealer

b. Joint filler

A record of joint sealant and filler materials used shall be furnished, in duplicate, to the Contracting Officer in the following format:

MILITARY BASE/AREA	MATERIAL	SPECIFICATION DESIGNATION/TYPE	MANUFACTURER
______	______	______	______
______	______	______	______

MATERIAL USED (MFR DESIG)	EXACT ON-SITE LOCATION	QUANTITY OF SEALANT	DATE APPLIED
______	______	______	______
______	______	______	______

1.3 DELIVERY, STORAGE, AND HANDLING

Inspect for damage, unload, and store materials delivered to site in accordance with manufacturer's instructions.

1.3.1 Joint Seal Materials

Deliver liquid joint sealants and lubricants in original sealed containers and protect from freezing and high temperatures. Store preformed joint fillers in a manner to maintain straightness and avoid damage.

1.3.2 Dowel Bars

Store dowel bars on pallets or wooden sleepers in a manner to avoid excessive rusting or contamination with soil, grease, oil, or other objectionable material.

1.4 ENVIRONMENTAL REQUIREMENTS

Forming of joints or applying joint sealants shall not proceed when the underlying layer or surface is frozen, or when, in the opinion of the Contracting Officer, weather conditions will prevent the proper installation of the joint sealants. During installation, surfaces shall be dry and sealant and bond breakers shall be protected from moisture.

1.5 TRAFFIC CONTROL

Do not permit vehicular or heavy equipment traffic on the pavement in area of the joints being sealed during the protection and curing period of joint sealant. At end of curing period, traffic may be permitted on pavement when approved.

1.6 EQUIPMENT

Maintain machines, tools, and other equipment used in performance of work in proper working conditions at all times. Furnish necessary equipment and accessories to install preformed joint filler, preformed compression seal, and liquid sealant in hardened concrete in accordance with equipment list. Concrete saws shall be adequate to remove filler and saw grooves for all joints.

1.6.1 Joint and Pavement Cleaning Equipment

1.6.1.1 Sandblasting Equipment

Sandblasting equipment for cleaning joints shall include an air compressor, hose, and nozzles of proper size, shape and opening to produce a clean joint. Equip compressor with traps that will maintain compressed air free of oil and water.

1.6.1.2 Power Saws

Concrete saws shall be self-propelled and capable of sawing joints in concrete to indicated width, depth and alignment without spalling or ravelling of concrete and at a production rate to avoid uncontrolled cracking.

1.6.1.3 Vacuum Sweeper

Self-propelled, vacuum pickup sweeper capable of removing saw cuttings, loose sand, water, joint material, and debris from pavement surface.

1.6.2 Joint Sealing Equipment

Joint sealing equipment shall be of a type required by joint seal manufacturer's installation instructions. Equipment shall be capable of installing sealant to depths, widths and tolerances indicated. Inspect equipment periodically during installation of sealant as required but not less than once each work day, to ensure the equipment is functioning properly. If malfunctions are noted, joint sealing shall not proceed until they are corrected.

1.6.2.1 Preformed Joint Seal

Install seals with equipment recommended in writing by sealant manufacturer. Equipment shall be capable of installing joint seal to indicated depth without damaging, distorting, or stretching seal material.

1.6.2.2 Equipment for Silicone Sealant

Equipment for silicone sealant shall be air-powered pump, components, and hoses as recommended by the sealant manufacturer. Hoses and seals shall be lined to prevent moisture penetration and withstand pumping pressures. Equipment shall be free of contamination from previously used to other type sealant.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Joint Filler

2.1.1.1 For Expansion Joints

Preformed joint filler, ASTM D 1751 or ASTM D 1752, Type II or Type III. Filler must be compatible with joint sealer material.

2.1.2 Bond Breakers

2.1.2.1 Blocking Media

Compressible, non-shrinkable, nonreactive with joint sealant and nonabsorption type such as plastic rod, free of oils or bitumens. Blocking media shall have a water absorption of not more than 5 percent by weight when tested in accordance with ASTM C 509. Blocking media shall be consistent with joint seal manufacturer's installation instructions and be at least 25 percent larger in diameter than width of joints as shown.

2.1.3 Joint Sealants

2.1.3.1 Single Component Cold-Applied Silicone

Silicone sealant shall be self-leveling, non-acid curing, and meet the following requirements.

TEST	TEST METHOD	REQUIREMENTS
Weight Loss	ASTM C 792 Modified (See Note 1)	10 percent max.
Flow	ASTM C 639 (Type I)	Smooth and level
Extrusion Rate	ASTM C 603	30 sec. max.
Tack Free Time	ASTM C 679	5 hours max.
Hardness (Shore 00) (See Note 2)	ASTM C 661	30 - 80
Tensile Stress at 150 Percent Elongation (See Note 2)	ASTM D 412 (Die C)	207 kPa
Percent Elongation (See Note 2)	ASTM D 412 (Die C)	700 min.
Accelerated Weathering	ASTM C 793	Pass 5000 hours
Bond and Movement Capability	ASTM C 719	Pass 10 cycles at $\pm$50 percent movement (no adhesion or cohesion failure)
Flame Resistant	FS SS-S-200	Pass

NOTES:

1. Percent weight loss of wet (uncured) sample after placing in forced-draft oven maintained at 70 degrees at $\pm$ 2 degrees C or two hours.

2. Specimen cured 21 days at 23 degrees $\pm$ 2 degrees C and 50 percent.

ACCELERATED WEATHERING FACTORY TEST REPORT. For Accelerated Weathering test, in lieu of testing of actual joint sealant to be used on the project, a report of a factory test, performed within two years of

TEST	TEST METHOD	REQUIREMENTS

contract award, may be submitted.

2.1.3.2 Primers

Select concrete primer recommended by manufacturer of proposed liquid joint sealant.

2.1.3.3 Preformed Compression Seals

ASTM D 2628. ASTM D 2835, for lubricant.

2.1.4 Dowel Bars

Bars shall conform to ASTM A 615/A 615M, Grade 300 for plain billet-steel bars of size and length indicated. Remove burrs and projections from bars. Coat sliding portion of each bar with shop applied paint conforming to FS TT-P-664. For doweled expansion joints, fit outer end of sliding portion of each dowel with a tight-fitting metal sleeve which conforms to manufacturer's recommendation for dowel bars.

2.1.5 Dowel Assemblies

Support dowels with steel baskets or dowel assemblies. Supports shall conform to manufacturers recommendations for rigid welded dowel assemblies, heavy duty type. Weld spacer wires parallel to dowels and weld alternate ends of dowels to sides of assembly. At expansion joints, fit dowels with bar tubes or U-shaped channel caps. Sliding surfaces shall be parallel with longitudinal axis of pavement within a tolerance of 3 mm per 3 m. Sliding end of assembly crossing joint shall alternate on each side of joint for all dowels in each joint.

PART 3 EXECUTION

3.1 PREPARATION OF SEALANTS

3.1.1 Liquid Sealants

Prior to use, inspect liquid joint seal to ensure product has not become damaged during shipping and storage, material is of proper lot number and has not reached its shelf life retest date.

3.1.2 Preformed Joint Fillers

Prior to installing inspect preformed joint fillers to ensure they are straight, without damage, and resilient.

3.2 JOINTS

Joints shall be type shown and shall form a regular rectangular pattern. Joints shall conform to details shown. Seal joints by procedures indicated. Preformed joint filler installed for expansion joints shall be securely held in position during concreting operations. Wherever curved pavement edges occur, make joints to intersect tangents to curve at right angles. Joints shall be in a continuous straight line extending from edge to edge of pavement. Do not stagger joints in abutting pavements except where shown. Protect joints from curing compounds by covering with tape or rope. Take necessary precautions to ensure proper curing at joints.

3.2.1 Sawing of Joints

Sawing will be conducted when concrete has hardened sufficiently to prevent ravelling or flaking along edges of saw cut and before uncontrolled shrinkage cracking of pavement occurs. Mark alignment of joints by chalk line or other suitable guide. Saw cuts shall not vary from required alignment by more than 13 mm in 3 m. Saw cutting shall be carried on both during the day and at night as required. A supply of saw blades and at least one stand-by sawing unit in working condition will be readily available during sawing operations. Discontinue sawing if a crack develops ahead of a saw cut. If uncontrolled cracking has occurred do not saw cut along the cracks but notify the Contracting Officer immediately.

3.2.2 Protection of Joints

Immediately after each joint is sawed, thoroughly clean saw cut and adjacent concrete surface by flushing with water and blowing with compressed air to remove waste. Respray curing compound on surfaces affected by sawing and cleaning operations but do not permit curing compound into joints. Protect joints from intrusion of foreign materials by installation of blocking media or separating tape as indicated. Do not seal joints until concrete has cured sufficiently as required by joint sealant manufacturer's instructions.

3.2.3 Preformed Compression Seals

Install preformed compression seals in a straight line and plumbed vertically in accordance with manufacturers requirements.

3.2.4 Joints at Vertical Surfaces

Construct joints where slabs abut light pads, catch basins, manholes, footings, walls, columns, and structures as expansion joints, 19 mm wide and full depth or thickness of slab. Provide joints with preformed joint filler and joint sealant and form the joints by placing joint filler against the adjacent structure. Keep filler in place with stakes or other approved means until concrete is placed against filler. Fit abutting sections or ends of filler material tightly together to prevent concrete from entering expansion joint space.

3.2.5 Expansion Joints

Expansion joints shall have dimensions and spacing shown, and be filled with preformed joint filler and sealant. Hold filler in place accurately and securely during the placing and finishing of concrete. Use metal supports to support filler and protect material from damage during concrete operations. A bulkhead, when used, shall have sufficient strength to remain straight from edge to edge of slab when concrete is placed against it. Stake bulkhead in place securely at right angles to longitudinal or transverse axis and surfaces of concrete slab. Space and drive flat metal stakes to hold filler firmly in position. Deposit concrete and compact and strike off before bulkhead is removed. Do not remove stakes until the concrete has been finished. Under no circumstances shall concrete be left above expansion material or across joint at any point. Cut away carefully concrete spanning ends of the joint next to forms after forms are removed. Fit abutting sections of joint filler material tightly together to prevent concrete from entering expansion joint space.

3.2.6 Contraction Joints

Saw joints to dimensions indicated. Joint lines shall be within specified tolerance, straight, and extend for width of transverse joint, and for entire length of longitudinal joint.

3.2.7 Construction Joints

3.2.7.1 Dowelled Construction Joints

Provide butt type joints with dowels as indicated by placing fresh concrete against hardened concrete. Clean vertical surface of hardened concrete and then coat with curing compound or asphalt emulsion bond breaker before concrete is placed. After concrete has cured, saw joint line in accordance with procedures specified for sawing joints and to dimensions shown.

3.2.7.2 Emergency Stops

If an emergency stop occurs remove the concrete back to indicated location of transverse joint and install a dowelled construction joint as shown.

3.2.8 Preparation of Joints

Seal joints unless otherwise indicated. Immediately before installation of sealant, thoroughly clean joints until laitance, curing compound, preformed joint filler, and protrusions of hardened concrete are removed from sides and upper edges of joint space.

3.2.8.1 Cleaning of Sawed Joints

Use a power-driven concrete saw to saw through preformed joint filler and to widen joint to indicated dimensions. Blow loosened materials from joint with compressed air. Clean exposed concrete joint faces and pavement surfaces extending at least 25 mm from edges of joints by thoroughly sandblasting and air blowing until surfaces are free of dust, dirt, curing compound, preformed joint filler, and other material that might prevent bonding of sealer to concrete.

3.2.9 Disposal of Debris

Remove from joints and pavement surface saw cuttings, excess joint material, dirt, water, sand, and other debris. Dispose of the debris immediately in accordance with Section 02220, "Site Demolition."

3.3 INSTALLATION

Joint preparation, primer and sealant shall be in accordance with joint seal manufacturer's instructions. Install a test section of 150 m at start of sealing operation for each type sealant to be used. Test section shall meet contract requirements. Contracting Officer shall be notified upon completion of test section.

3.3.1 Bond Breakers

Immediately after joints receive final cleaning, install specified bond breaker in the bottom of joint reservoir.

3.3.2 Bonding Agents and Primer

Apply joint seal bonding agents and primer in accordance with joint seal manufacturer's instructions. When primed joint becomes dusty or otherwise contaminated prior to sealing, re-sandblast, air blow, and re-prime joint.

3.3.3 Installation of Liquid Sealants

Do not install liquid joint seals until test section has been inspected and approved by Contracting Officer. Joints shall be dry and free of debris and contaminants prior to placement of sealant. Fill joints to depths and tolerances indicated without formation of voids or entrapped air. Remove excess or spilled sealant from pavement and discard.

3.3.4 Installation of Preformed Compression Seal

Install preformed compression seals in accordance with manufacturer's instructions to dimensions and tolerances indicated. Seal shall be plumb and shall not be stretched or twisted during installation.

3.3.5 Dowel Bars

Install bars accurately aligned, vertically and horizontally, at indicated locations and to dimensions and tolerances indicated. Before installation thoroughly grease sliding portion of each dowel. Dowels must remain in position during concrete placement and curing.

3.3.6 Dowel Assemblies

Dowels in longitudinal construction joints must be drilled and epoxied with an approved epoxy. Before construction commences method for installing dowel bars shall be approved.

3.3.7 Tie Bars

Install bars, accurately aligned horizontally and vertically, at indicated locations.

3.4 FIELD QUALITY CONTROL

3.4.1 Joints

Joints which have been cleaned and have backer rods or bond breaking tape installed shall be inspected and approved prior to sealing.

3.4.2 Joint Sealer

Inspect installed joint seals for conformance to contract requirements, joint seal manufacturer's instructions, and test section. Obtain approval for each joint seal installation.

3.4.3 Dowels

Inspect dowel placement prior to placing concrete to assure that dowels are of size indicated, and are spaced, aligned and painted and oiled as specified. Dowels shall not deviate from vertical or horizontal alignment after concrete has been placed by more than 3 mm per 300 mm.

3.5 ACCEPTANCE

Joint sealer that fails to cure properly, or fails to bond to joint walls, or reverts to uncured state or fails in cohesion, or shows excessive air voids, blisters, surface defects, swelling, or other deficiencies, or is not recessed within indicated tolerances shall be rejected. Remove rejected sealer and reclean and reseal joints in accordance with the specifications.

-- End of Section --

SECTION 02821

CHAIN LINK FENCE
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS RR-F-191	(Rev. K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General Specification)
FS RR-F-191/1	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) (Detail Specification)
FS RR-F-191/3	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) (Detail Specification)
FS RR-F-191/4	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) (Detail Specification)

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-02 Manufacturer's Catalog Data

a. Chain-link fencing components

b. Accessories

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 CHAIN-LINK FENCING AND ACCESSORIES

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

2.1.1 Fabric

FS RR-F-191/1; Type I, zinc-coated steel, 9-gage. Mesh size, 50 mm. Provide knuckled at both selvages. Height of fabric, as indicated.

2.1.2 Fence Slatting

Fence slatting is to be of extruded high density virgin polyethylene, containing color pigmentation and U.V. inhibitors to resist the effects of ultra violet radiation from sunlight and extend the colorfastness of the material for a minimum of 15 years service without visible degradation. Color of slats shall be Brown.

2.1.3 Posts and Braces

FS RR-F-191/3 line posts, end posts, corner posts and braces; Class 1, steel pipe, Grade A or B.

2.1.4 Fencing Accessories

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.1.5 Concrete

Provide as specified in Section 03300, "Cast-In-Place Concrete."

2.1.6 Grout

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation. Compact fill used to establish fence line.

3.1.2 Excavation

Excavate to dimensions indicated for concrete-embedded items. Clear post holes of loose material. Dispose of waste material outside limits of station.

3.2 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.1 Post Spacing

Provide line posts spacing to match existing fence, not to exceed on center. Provide corner or pull posts, with bracing in both directions, for changes in direction of 0.26 rad or more, or for abrupt changes in grade.

3.2.2 Post Setting

Set posts plumb. Allow concrete and grout to cure a minimum of 72 hours before performing other work on posts.

3.2.2.1 Earth

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape.

3.2.2.2 Concrete Slabs

Set posts into zinc-coated sleeves, set in concrete slabs to a minimum depth of 300 mm. Fill sleeve joint with lead, nonshrink grout, or other approved material.

3.2.3 Bracing

Brace corner posts to nearest post with a horizontal brace used as a compression member, placed at least 300 mm below top of fence, and a diagonal truss rod and truss tightener used as a tension member.

3.2.4 Top and Bottom Tension Wires

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 200 mm of respective fabric line.

3.2.5 Fabric

Pull fabric taut and secure fabric to top wire and bottom wire, close to both sides of each post and at maximum intervals of 600 mm on center. Secure fabric to posts using stretcher bars, ties or clips spaced 375 mm on center, or by integrally weaving to integral fastening loops of end and corner posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric so that bottom of fabric is 50 mm above ground level. Install fence fabric to provide approximately 50 mm deflection at center of fabric span between two posts, when a force of approximately 133 N is applied perpendicular to fabric. Fabric should return to its original position when force is removed.

3.3 ACCESSORIES INSTALLATION

3.3.1 Post Caps

Design post caps to accommodate top tension wire. Install post caps as recommended by the manufacturer.

3.3.2 Supporting Arms

Design supporting arms to accommodate top tension wire. Install supporting arms as recommended by manufacturer. In addition to manufacturer's standard connections, permanently secure supporting arms to posts. Studs driven by low-velocity powder-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by powder-actuated tools with gray iron or other material that will fracture.

3.3.3 Barbed Wire

Install barbed wire on supporting arms above fence posts. Extend each end member of gate frames sufficiently above top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten each strand to each supporting arm or extended member. Secure wires in accordance with fence manufacturer's recommendations.

3.4 CLEANUP

Remove waste fencing materials and other debris from the station.

-- End of Section --

SECTION 03300

CAST-IN-PLACE CONCRETE
06/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M182	(1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(1990) Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1996) Structural Concrete for Buildings
ACI 302.1R	(1996) Concrete Floor and Slab Construction
ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 304.2R	(1996) Placing Concrete by Pumping Methods
ACI 305R	(1991) Hot Weather Concreting
ACI 306.1	(1990) Cold Weather Concreting
ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318M	(1992) Building Code Requirements for Reinforced Concrete (Metric)
ACI 347R	(1994) Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1997) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 123/A 123M	(1997; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	(1997) Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1997) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 171	(1997) Sheet Materials for Curing Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 173	(1994; Rev. A) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(1995) Making and Curing Concrete Test Specimens in Laboratory
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete

ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1190	(1996) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1854	(1996) Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS-1	(1995) Construction and Industrial Plywood

1.2 DEFINITIONS

a. "Cementitious material" as used herein shall include all portland cement, pozzolan, fly ash and ground iron blast-furnace slag.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

1.3 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Materials for curing concrete

b. Joint sealants

c. Joint filler

1.3.2 SD-04, Drawings

a. Reinforcing steel G

Reproductions of contract drawings are unacceptable.

1.3.2.1 Reinforcing Steel

ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.3.3 SD-05, Design Data

a. Concrete mix design G

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. An identical concrete mix design previously approved within the past 12 months by the [Atlantic Division, Naval Facilities Engineering Command, Code 406, 1510 Gilbert Street, Norfolk, Va. 23511, as an annual mix design submittal, may be used without further approval when accompanied by a letter signed by an authorized representative of the the concrete supplier indicating the mix number, cement type, water-cement ratio, slump, maximum nominal aggregate size, admixtures, percentage of air entrainment, and a statement that the materials to be used are on the list of approved certifications. In addition, copies of the fly ash and pozzolan test results shall be submitted. The approval of fly ash and pozzolan tests results shall have been within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

1.3.4 SD-08, Statements

a. Curing concrete elements

b. Pumping concrete

1.3.4.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.3.4.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal shall include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete will be pumped.

1.3.5 SD-10, Test Reports

a. Concrete mix design G

1.3.5.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cement, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Obtain approval before concrete placement.

1.3.5.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.3.5.3 Ground Iron Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground iron blast-furnace slag. Submit test results performed within 6 months of submittal date.

1.3.6 SD-12, Field Test Reports

a. Compressive strength tests G

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood: PS-1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Steel form surfaces shall not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318M except as otherwise specified. The compressive strength (f'c) of the concrete for each portion of the structure(s) shall be as indicated and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (MPa)	ASTM C 33 Maximum Nominal Aggregate (Size No.)	Range of Slump (mm)	Maximum Water-Cement Ratio] (by weight)	Air Entr. (percent)
All areas	42	57 or 67	75	0.45	5

Maximum slump shown above may be increased 25 mm for methods of consolidation other than vibration. Slump may be increased to 200 mm when superplasticizers are used. Provide air entrainment using air-entraining admixture. Air entrainment shall be within plus or minus 1.5 percent of the valve specified..

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1. The trial mixture shall use at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required will be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan and ground granulated blast-furnace slag by weight equivalency method. Laboratory trial mixture shall be designed for maximum permitted slump and air content. Each combination of material proposed for use shall have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39 for 7 and 28 days. From these results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition a curve shall be plotted showing the relationship between 7 and 28 day strengths.

2.3.1.2 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as follows:

a. For f'c over 35 MPa, 10 MPa plus f'c.

2.4 MATERIALS

2.2.1 Cement

ASTM C 150, Type I or II or ASTM C 595M, Type IP(MS) or IS(MS) blended cement except as modified herein. The blended cement shall consist of a mixture of ASTM C 150, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground iron blast-furnace slag. The pozzolan or fly ash content shall not exceed 25 percent by weight of the total cementitious material. The ground iron blast-furnace slag shall not exceed 50 percent by weight of total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Types N and F. Add with cement.

2.4.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 120.

2.4.3 Water

Water shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.4 Aggregates

ASTM C 33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.4.5 Nonshrink Grout

ASTM C 1107.

2.4.6 Admixtures

ASTM C 494: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.6.1 Air-Entraining

ASTM C 260.

2.4.6.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494, Type F and Type G (HRWR retarding admixture) and ASTM C 1017.

2.4.7 Materials for Curing Concrete

2.4.7.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.7.2 Pervious Sheeting

AASHTO M182.

2.4.7.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.8 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.4.9 Expansion/Contraction Joint Filler

ASTM D 1751 or ASTM D 1752, 13 mm thick, unless otherwise indicated.

2.4.10 Joint Sealants

2.4.10.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T. ASTM D 1854 for surfaces subjected to jet fuel.

2.4.10.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.5 REINFORCEMENT

Bars, fabrics, connectors, and chairs shall be galvanized.

2.5.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A 615/A 615M and ASTM A 617/A 617M with the bars marked A, S, W, Grade 420 ; or ASTM A 616/A 616M with the bars marked R, Grade 420 . Galvanized, ASTM A 123/A 123M.

2.5.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Welded Wire Fabric

ASTM A 185 or ASTM A 497. Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.4 Wire

ASTM A 82 or ASTM A 496.

2.5.5 Reinforcing Bar Supports

Provide bar ties and supports of coated or noncorrodible material.

PART 3 EXECUTION

3.1 FORMS

ACI 301. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 20 mm unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

3.1.1 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.1.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal.

3.1.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.1.3 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, slabs and beams over 3000 mm in span and cantilevers over 1200 mm shall be reshored for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carrying capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.2 Formed Surfaces

3.2.1 Tolerances

ACI 347R and as indicated.

3.2.2 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used.

3.3 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.3.1 Reinforcement Supports

Place reinforcement and secure with galvanized or noncorrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other noncorrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.3.2 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 50 mm.

3.3.3 Cover

ACI 301 for minimum coverage, unless otherwise indicated.

3.3.4 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.3.5 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.3.6 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 13 mm wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.4 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94, ACI 301, ACI 302.1R, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.4.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.4.2 Mixing

ASTM C 94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 29 degrees C except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.4.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.5 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 1 m from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 3 m centers maximum in each direction when pouring interior slabs and on 6 m centers maximum for exterior slabs.

3.5.1 Vibration

ACI 301. Furnish a spare vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 100 mm in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 100 mm or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 500 mm apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 500 mm maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.5.2 Pumping

ACI 304R and ACI 304.2R. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 50 mm. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Rapid changes in pipe sizes shall be avoided. Maximum size of course aggregate shall be limited to 33 percent of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40 percent of the pipe diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

3.5.3 Cold Weather

ACI 306.1. Do not allow concrete temperature to decrease below 10 degrees C Obtain approval prior to placing concrete when the ambient temperature is below 4 degrees C or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 10 degrees C minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 3 degrees C in any 1 hour and 10 degrees C per 24 hours after heat application.

3.5.4 Hot Weather

ACI 305R. Maintain required concrete temperature using Figure 2.1.5 in ACI 305R to prevent the evaporation rate from exceeding 1 kg per square meter of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.6 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.6.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 600 square mm surface area or 6 mmmaximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.6.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.

3.6.3 Formed Surfaces

3.6.3.1 Tolerances

ACI 117 and as indicated.

3.6.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch this holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 6 mm in height.

3.7 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

3.7.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.7.1.1 Floated

Use for exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, surface shall be checked with a 3 meter straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. High spots shall be cut down and low spots filled during this procedure to produce a surface level within 6 mm in 3 m.

3.7.1.2 Steel Troweled

Use for Guard House floor. First, provide a floated finish. The finish shall next be power troweled two times, and finally hand troweled. The first troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks and uniform in texture and appearance. The finished surface shall produce a surface level to within 6 mm in 3 m. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding.

3.7.1.3 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.7.2 Concrete Walks

Provide 100 mm thick minimum. Provide contraction joints spaced every 1500 lineal mm unless otherwise indicated. Cut contraction joints 25 mm deep with a jointing tool after the surface has been finished. Provide 13 mm thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 15 m maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 6 mm in 1500 mm.

3.7.3 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.7.4 Curbs

Provide contraction joints spaced every 3 m maximum unless otherwise indicated. Cut contraction joints 20 mm deep with a jointing tool after the surface has been finished. Provide expansion joints 13 mm thick and spaced every 30 mm maximum unless otherwise indicated. Perform pavement finish.

3.8 CURING AND PROTECTION

ACI 301 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforment, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.8.1 Moist Curing

Remove water without erosion or damage to the structure.

3.8.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete. For temperatures between 4 and 10 degrees C, increase the curing period by 50 percent.

3.8.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 4 and 10 degrees C, increase the curing period by 50 percent.

3.8.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 150 mm over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.8.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 300 mm minimum. Provide sheeting not less than 450 mm wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.8.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 1 kg pf water per square meter per hour.

3.8.2.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 5 square meters maximum per L of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.8.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.8.3 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.8.4 Curing Periods

ACI 301 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that will be in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Contracting Officer.

3.8.5 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods shall be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.9.2 Testing

3.9.2.1 Slump Tests

ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 16 cubic meters (maximum) of concrete.

3.9.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 10 degrees C and above 27 degrees C) for each batch (minimum) or every 16 cubic meters (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.9.2.3 Compressive Strength Tests

ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 120 cubic meters of concrete, nor less than once for each 500 square meters of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 3 MPa, take a minimum of three ASTM C 42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.9.2.4 Air Content

ASTM C 173 or ASTM C 231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

-- End of Section --

SECTION 03410

PLANT-PRECAST STRUCTURAL CONCRETE
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB14	(1996) Highway Bridges

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 309R	(1996) Consolidation of Concrete
ACI 318M	(1995) Building Code Requirements for Reinforced Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M	(1995) Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	(1997; Rev. A) Carbon Structural Steel
ASTM A 47M	(1990) Ferritic Malleable Iron Castings (Metric)
ASTM A 123	(1997; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767M	(1997) Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997; Rev. A) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1998) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and Prestressed Concrete
PCI MNL-124	(1989) Fire Resistance of Precast Prestressed Concrete

UNDERWRITERS LABORATORIES INC. (UL)

UL FRD (1995) Fire Resistance Directory

1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Anchorage and lifting inserts and devices

b. Bearing pads

1.3.2 SD-04 Drawings

a. Drawings of precast members G

1.3.2.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

a. Marking of members for erection

b. Connections for work of other trades

c. Connections between members, and connections between members and other construction

d. Location and size of openings

e. Headers for openings

f. Joints between members, and joints between members and other construction

g. Reinforcing details

h. Material properties of steel and concrete used

i. Lifting and erection inserts

j. Dimensions and surface finishes of each member

k. Erection sequence and handling requirements

l. All loads used in design (such as live, dead, handling, and erection)

m. Bracing/shoring required

n. Areas to receive toppings, topping thickness.

1.3.3 SD-05 Design Data

a. Precast concrete members design calculations G

b. Concrete mix design G

1.3.3.1 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication.

1.3.3.2 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.3.4 SD-08 Statements

a. Fabrication

Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

1.3.5 SD-11 Factory Test Reports

a. Contractor-furnished mix design G

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

1.3.6 SD-18 Records

a. Concrete batch ticket information

1.3.6.1 Record Requirement

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.4 QUALITY CONTROL

1.4.1 Precast Concrete Member Design

ACI 318M and the PCI MNL-120. Design precast members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design precast members for handling without cracking in accordance with the PCI MNL-120. Precast members where indicated shall have a fire rating as indicated in accordance with UL FRD, or as designed in accordance with PCI MNL-124.

1.4.2 PCI Quality Certifications

PCI MNL-116. At the precast manufacturer's option, in lieu of core samples, ACI 318M, full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.4.2.1 Product Quality Control

PCI MNL-116 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

1.4.2.2 Product Quality Control

Plants shall be certified by the PCI Plant Certification Program for Category C1 work.

1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

1.6 FACTORY INSPECTION

At the option of the Contracting Officer, precast units shall be inspected by the QC Representative prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

PART 2 PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318M. The minimum compressive strength of concrete at 28 days shall be 42 MPa, unless otherwise indicated. Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595M Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Aggregates Selection

ASTM C 33, Size 57, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

2.2.4 Grout

2.2.4.1 Nonshrink Grout

ASTM C 1107.

2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Accelerating

ASTM C 494, Type C or E.

2.2.5.3 Water Reducing

ASTM C 494, Type A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 615/A 615M, Grade 420; ASTM A 617/A 617M, Grade 420; or ASTM A 616/A 616M, Grade 420. Galvanized rebar ASTM A 767M, Grade 420; ASTM A 780.

2.2.7 Metal Accessories

Provide ASTM A 123 or ASTM A 153/A 153M galvanized.

2.2.7.1 Inserts

ASTM A 47M, Grade 22010, or ASTM A 27/A 27M Grade 415-205.

2.2.7.2 Structural Steel

ASTM A 36/A 36M.

2.2.7.3 Bolts

ASTM A 307; ASTM A 325M.

2.2.7.4 Nuts

ASTM A 563M.

2.2.7.5 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436M washers for ASTM A 325M bolts.

2.2.8 Bearing Pads

2.2.8.1 Elastomeric

AASHTO HB14, for plain neoprene bearings.

2.3 FABRICATION

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 19 mm, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318M for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 304R and ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 90 degrees C. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.5 mm in width, may be accepted, except that cracks larger than 0.1 mm in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.5 mm in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

2.3.4.1 Traffic/Walking Surfaces

Provide a floated then broomed finish.

2.3.4.2 Unformed Surfaces

Provide a floated finish.

2.3.4.3 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a commercial grade surface finish.

b. Exposed Surfaces: Provide a commercial grade surface finish.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast members.

3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Grind smooth visible welds in the finished installation.

3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than .3 m in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill indicated keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

-- End of Section --

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SECTION 03412

PLANT-PRECAST PRESTRESSED STRUCTURAL CONCRETE
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB14	(1996) Highway Bridges

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 309R	(1996) Consolidation of Concrete
ACI 318M	(1995) Building Code Requirements for Reinforced Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 416/A 416M	(1996) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997; Rev. A) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1998) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and Prestressed Concrete

1.2 DESCRIPTION OF WORK

The work includes the provision of precast, prestressed concrete herein referred to as prestressed members. Prestressed members shall be the product of a manufacturer specializing in the production of precast prestressed concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.3.1 SD-04 Drawings

a. Drawings for precast prestressed concrete members G

1.3.1.1 Content of Drawings

Submit drawings indicating complete information for the fabrication, handling, and erection of the prestressed member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

a. Marking of members for erection;

b. Connections for work of other trades;

c. Connections between members, and connections between members and other construction;

d. Location and size of openings which cut prestressing strands, or require the relocation of prestressing strands to be cast in the member;

e. Headers for openings;

f. Joints between members, and joints between members and other construction;

g. Reinforcing, including prestressing steel details;

h. Schedule and sequence of tensioning and detensioning prestressing strands;

i. Material properties of steel and concrete used;

j. Lifting and erection inserts;

k. Dimensions and surface finishes of each member;

l. Estimated camber;

m. Erection sequence and handling requirements;

n. All loads used in design (such as live, dead, handling, and erection);

o. Bracing/shoring required; and

p. Areas to receive toppings, topping thickness.

1.3.2 SD-05 Design Data

a. Precast prestressed concrete design calculations G

b. Concrete mix design G

1.3.2.1 Design Calculations

Submit calculations reflecting design in accordance with the paragraph entitled "Precast Prestressed Concrete Member Design." Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. Submit calculations for volume change as part of the design calculations.

1.3.2.2 Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.3.3 SD-08 Statements

a. Quality control procedures

1.3.3.1 Procedures

Submit quality control procedures established in accordance with PCI MNL-116 by the prestressing manufacturer.

1.3.4 SD-11 Factory Test Reports

a. Concrete mix test reports

1.3.4.1 Requirements

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

1.3.5 SD-18 Records

a. Concrete batch ticket information

1.3.5.1 Batch Test

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.4 QUALITY CONTROL

1.4.1 PCI Quality Certifications

ACI 318M and the PCI MNL-120. Design prestressed members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design prestressed members for handling without cracking in accordance with the PCI MNL-120.

1.4.1.1 Product Quality Control

PCI MNL-116 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

or

1.4.1.2 Product Quality Control

Plants shall be certified by the PCI Plant Certification Program for category C3 work.

1.4.2 Fabrication, Sampling, and Testing

PCI MNL-116, at the prestressor's option, in lieu of core samples, ACI 318M full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Lift and support prestressed members at the lifting and supporting points indicated on the detail drawings. Store prestressed members off the ground. Separate stacked prestressed members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

PART 2 PRODUCTS

2.1 CONCRETE

ACI 318M, for contractor furnished mix design. The minimum compressive strength of concrete at 28 days shall be 42 MPa, unless otherwise indicated. Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595M Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Grading and Composition

ASTM C 33, Size 57, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.2.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

2.2.4 Nonshrink Grout

ASTM C 1107.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Accelerating

ASTM C 494, Type C or E.

2.2.5.3 Water Reducing

ASTM C 494, Types A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

Galvanized rebar ASTM A 767, Grade 420; ASTM A 780.

2.2.6.2 Prestressing Strands

a. Seven Wire Stressed Relieved: ASTM A 416/A 416M for low relaxation wire.

2.2.7 Bearing Pads

2.2.7.1 Elastomeric

AASHTO HB14, for plain neoprene bearings.

2.2.8 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.3 FABRICATION

PCI MNL-116, unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 20 mm, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318M for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between prestressed and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections. Provide curvature or drape of the prestressing strands using approved hold-down devices.

2.3.3 Inserts

When the ends of the prestressed member will be exposed, recess the prestressing stands using inserts. After detensioning, remove inserts and fill the recess with nonshrink grout.

2.3.4 Concrete

2.3.4.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.4.2 Concrete Placing

ACI 304R , ACI 305R for hot weather concreting , ACI 306.1 for cold weather concreting, and ACI 309R, unless otherwise specified.

2.3.4.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 85 degrees C. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.5 Prestressing

Do not transfer prestressing forces during detensioning until the concrete has reached a minimum compressive strength of 24 MPa, unless a higher strength is required by the Contractor furnished design.

2.3.6 Surface Finish

Repairs to honeycombed sections located in a bearing area shall be approved by the Contracting Officer prior to repairs. Prestressed members which contain honeycombed sections deep enough to expose prestressing strands shall be rejected. Prestressed members containing hairline cracks which are visible and are less than 0.5 mm in width, may be accepted. However, prestressed members which contain cracks greater than 0.5 mm in width shall be approved by the Contracting Officer. When approved, the member shall be repaired. Any prestressed member that is structurally impaired shall be rejected.

2.3.6.1 Traffic/Walking Surfaces

Provide a floated and broomed finish.

2.3.6.2 Unformed Surfaces

Provide a floated finish.

2.3.6.3 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a commercial grade surface finish.

b. Exposed Surfaces: Provide a commercial grade surface finish.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, check prestressed members for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, prestressed members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new prestressed members.

3.2 ERECTION

Erect prestressed members after the concrete has attained the specified compressive strength, unless otherwise approved by the prestressing manufacturer. In addition, prestressed members shall not be rigidly fixed in position until the prestressed member has "aged" 90 days after detensioning. Erect in accordance with the approved detail drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Provide a 1:500 tolerance, if no tolerance is specified. Brace prestressed members, unless design calculations submitted with the detail drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place prestressed members level, plumb, and square within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the prestressed member and adjacent prestressed members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Place prestressed members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 WELDING

AWS D1.4 for welding connections and reinforcing splices. Do not weld prestressing strands. Protect the concrete and prestressing strands from heat during welding.

3.5 OPENINGS

Holes or cuts requiring prestressing steel to be cut, which are not indicated on the approved detail drawing, shall only be made with the approval of the Contracting Officer and the prestressing manufacturer. Drill holes less than 300 mm in diameter with a diamond tipped core drill.

3.6 GROUTING

Clean and fill indicated keyways between prestressed members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

-- End of Section --

SECTION 05120

STRUCTURAL STEEL
06/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M013	(1983) Detailing for Steel Construction
AISC M016	(1989) ASD Manual of Steel Construction
AISC M017	(1992; Errata 1994) Connections
AISC S303	(1992) Steel Buildings and Bridges
AISC S329	(1996) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts
AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143	(1974; R 1994) Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)

ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563M	(1993) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(1994; Rev. C) High-Strength Low-Alloy Columbium-Vanadium of Structural Steel
ASTM A 852/A 852M	(1994) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM B 695	(1991) Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 827	(1995; Rev. A) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM C 1107	(1991; Rev. A) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959M	(1996) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1996) Structural Welding Code Steel

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC M016 and AISC M017 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

In AISC M016, AISC M017, AISC S335, AISC S303, and AISC S329, except as modified in this section, shall be considered a part of AISC M016 and AISC M017 and is referred to in this section as AISC M016 and AISC M017.

1.4 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.4.1 SD-02 Manufacturer's Catalog Data

a. Load indicator washers

1.4.2 SD-04, Drawings

a. Fabrication drawings G

1.4.2.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC M013, AISC M016 and AISC M017. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols.

1.4.3 SD-08, Statements

a. Erection plan

b. Welding procedures and qualifications

1.4.3.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.4.3.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

1.4.4 SD-10, Test Reports

a. Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

1.4.5 SD-13, Certificates

a. Nonshrink grout

b. Galvanizing

c. AISC Quality Certification

1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Sbd fabrication plant.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.2 High-Strength Structural Steel (Rail Fenders)

2.1.2.1 Low-Alloy Steel

ASTM A 572/A 572M. ASTM A 852/A 852M, plate.

2.1.3 Structural Steel Tubing

ASTM A 500, Grade B.

2.1.4 Steel Pipe

ASTM A 53, Type E or S, Grade B, weight class as indicated.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel , Steel Pipe

2.2.1.1 Bolts

ASTM A 325M, galvanized. Limit hardness value to less than Rockwell C-32. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563M, Grade A, galvanized, heavy hex style, except nuts under M36 may be provided in hex style.

2.2.1.3 Washers

ASTM F 436M, galvanized.

2.2.1.4 Load Indicator Washers

ASTM F 959M. Provide ASTM B 695, Class 50, Type 1 galvanizing.

2.2.2 High-Strength Structural Steel

2.2.2.1 Bolts

ASTM A 325M , Type 1, galvanized. Limit hardness value to less than

Rockwell C-32.

2.2.2.2 Nuts

ASTM A 563M , Grade and Style as specified in the applicable ASTM bolt standard, galvanized.

2.2.2.3 Washers

ASTM F 436M, galvanized.

2.2.2.4 Load Indicator Washers

ASTM F 959M. Provide ASTM B 695, Class 50, Type 1 galvanizing.

2.2.3 Foundation Anchorage

2.2.3.1 Bolts

ASTM A 307, galvanized.

2.2.3.2 Nuts

ASTM A 563 , Grade A, hex style, galvanized.

2.2.3.3 Washers

ASTM F 844, galvanized.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1.

2.3.2 Nonshrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage.

2.3.3 Welded Shear Stud Connectors

AWS D1.1.

2.4 GALVANIZING

ASTM A 123 or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.5 FABRICATION

2.5.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

PART 3 EXECUTION

3.1 ERECTION

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC S335. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 High-Strength Bolts

ASTM A 325M bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Provide load indicator washers in all high strength bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, or installation of alternate design fasteners, shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.2.1.1 Installation of Load Indicator Washers (LIW)

ASTM F 959M . Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436M washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening.

3.3 WELDING

AWS D1.1. Grind exposed welds smooth as indicated. Provide AWS D1.1 qualified welders, welding operators, and tackers.

3.4 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.5 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.5.1 Welds

3.5.1.1 Visual Inspection

AWS D1.1. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.5.1.2 Nondestructive Testing

AWS D1.1. Test locations shall be selected by the Contracting Officer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

3.5.2 Load Indicator Washers

3.5.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.38 mm gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.13 mm gap when the load indicator washer is placed under the turned element, as required by ASTM F 959M .

3.5.3 High-Strength Bolts

3.5.3.1 Inspection

Inspection procedures shall be in accordance with AISC S329, Section 9. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.5.3.2 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

3.5.4 Testing for Embrittlement

ASTM A 143 for steel products hot-dip galvanized after fabrication.

-- End of Section --

SECTION 05500

METAL FABRICATIONS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M180	(1989) Corrugated Sheet Steel Beams for Highway Guardrail

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S303	(1992) Steel Buildings and Bridges

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.3	(1995) Power-Actuated Fastening Systems
ANSI B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws Inch Series
ANSI B18.6.2	(1972; R 1993) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ANSI B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ASME/ANSI B18.21.2M	(1994) Lock Washers (Metric)
ASME/ANSI B18.22M	(1981; R 1990) Metric Plain Washers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1994) Carbon Structural Steel
ASTM A 47M	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 480M	(1997; Rev. A) General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 653/A 653M	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 786/A 786M	(1995) Rolled Steel Floor Plates
ASTM D 1187	(1995) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1996) Structural Welding Code Steel

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27	Fixed Ladders

FEDERAL SPECIFICATIONS (FS)

FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
FS RR-C-271	(Rev. D) Chains and Attachments, Welded and Weldless

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Ladders

b. Chains

c. Floor Plates, Patterned

1.2.2 SD-04, Drawings

a. Expansion joint covers, installation drawings G

b. Ladders, installation drawings G

c. Embedded angles and plates, installation drawings G

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC S303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

2.1.2 Stainless Steel

ASTM A 480M.

2.1.3 Structural Tubing

ASTM A 500.

2.1.4 Steel Pipe

ASTM A 53, Type E or S, Grade B.

2.1.5 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47M.

2.1.6 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.6.1 Lag Screws and Bolts

ANSI B18.2.1, type and grade best suited for the purpose.

2.1.6.2 Toggle Bolts

ANSI B18.2.1.

2.1.6.3 Bolts, Nuts, Studs and Rivets

ASME/ANSI B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.6.4 Powder Driven Fasteners

Follow safety provisions of ANSI A10.3.

2.1.6.5 Screws

ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3.

2.1.6.6 Washers

Provide plain washers to conform to ASME/ANSI B18.22M. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME/ANSI B18.21.2M .

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123, ASTM A 153/A 153M or ASTM A 653/A 653M, Z275 , as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3 CHAINS

FS RR-C-271 unless specified elsewhere.

2.4 GUARD POSTS

Provide 100 mm prime coated standard weight steel pipe as specified in ASTM A 53. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 17 MPa .

2.5 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 65 by 10 mm steel flats for stringers and 20 mm diameter steel rods for rungs. Rungs to be not less than 400 mm wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 175 mm . Provide heavy clip angles riveted or bolted to the stringer and drilled as indicated. Provide intermediate clip angles not over 1200 mm on centers.

2.6 FLOOR PLATES, PATTERNED

Floor plate ASTM A 786/A 786M. Size as indicated on drawings.

2.7 EXPANISION JOINT COVERS

Provide expansion joints covers fabricated from material conforming to ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123.

2.8 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123.

2.9 GUARDRAILS

Corrugated sheet steel beam guardrail to conform to the requirements of AASHTO M180, Type 1, Class A. Provide bolts and nuts as indicated, and to conform to the requirements of ASTM A 307.

PART 3 EXECUTION

3.1 INSTALLATION

Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

3.2 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.3 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than -15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C , unless approved by the Contracting Officer.

3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to concrete with not less than two 12 mm diameter expansion bolts. Install intermediate clip angles not over 1200 mm on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the concrete.

-- End of Section --

SECTION 06611

FIBER-REINFORCED PLASTICS (FRP)
12/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3647	(1984; R 1995) Classifying Reinforced Plastic Pultruded Shapes According to Composition
ASTM D 3917	(1996) Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes
ASTM D 4385	(1995) Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Structural FRP Shapes G

b. Trench Covers G

c. Lift Station Cover Plates G

Provide catalog cuts clearly showing product conformance to specification and load and deflection criteria.

1.2.2 SD-04, Drawings

a. Stairs G

b. Trench Covers G

c. Lift Station Cover Plates G

Show sizes. Submit for approval prior to fabrication. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, fasteners, clips, member sizes and lengths, connection details, blocks, copes, and cuts.

1.2.3 SD-06, Instructions

a. Epoxy Resin G

1.3 DELIVERY AND STORAGE

Protect from abrasion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and water.

PART 2 PRODUCTS

2.1 STRUCTURAL FRP SHAPES

ASTM D 3647, Type GCPF, pultruded with ASTM D 3917 dimensional tolerances. Defects shall not exceed ASTM D 4385, Level II. The FRP shapes shall be manufactured from an isophthalic polyester resin combined with longitudinal glass roving and continuous strand mat fiberglass reinforcement. The finished surface of the product shall be provided with a surfacing veil to provide resistance to ultraviolet degradation. The FRP shapes shall be a standard catalog product.

2.1.1 Resin

Isophthalic polyester with flame retardant additive.

2.1.2 Reinforcement

Glass reinforcement shall be Type C, chemical glass.

2.1.2.1 Continuous Strand Roving

Type E glass with chrome finish or silane coupling agent.

2.1.2.2 Continuous Strand Mat

Type E glass with silane finish and a styrene soluble binder.

2.2 STAIRS

Stairs shall be fabricated using structural FRP shapes.

2.3 LIFT STATION COVER PLATES AND TRENCH COVERS

One-piece construction made with structural FRP shapes. Exposed horizontal fiberglass shall have nonskid molded surface.

2.3.1 Fabrication

Not more than 5 mm clearance shall exist between cover and plate sections and their frames. Each section shall be readily removable, except as indicated on drawings. Adjacent sections shall fit together with transverse members forming uninterrupted straight line. Provide openings and holes as required. Provide openings in covers and plates indicated for protrusions as required for installing piping, wiring, and equipment. End cuts shall be coated with resin. Cover and plates which fit around protrusions shall be discontinuous at centerline of opening so each section is readily removable. Cover and plates shall be fabricated free from warps, twists, or other defects which affect appearance and serviceability. No section of Trench covers shall exceed 36 Kg.(80 lbs).

2.4 EPOXY RESIN BONDING COMPOUND

As recommended by FRP shape manufacturer, suitable for use in bonding together two pieces of FRP shapes and for use in a marine environment and contact with petroleum fuels. Minimum bond strength shall be equal to the strength of the FRP shapes.

2.5 FASTENERS AND ACCESSORIES

Bolts, hold down fasteners, and saddle clips shall be stainless steel.

2.6 LOADS AND DEFLECTION

Stairs, Trench Covers and Lift Station Cover Plates shall meet the design loads and deflection criteria indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Erect sections in place on supporting members with full, uniform bearing on supports. Wedges or shimming devices will not be permitted. Lock cover and plate sections securely in place with removable hold-down fasteners. Field cut and drill fiber reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiber glass products or using epoxy products; provide adequate ventilation.

-- End of Section --

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SECTION 06650

SOLID POLYMER FABRICATIONS
03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 570	1981 Test Method for Water Absorption of Plastics
ASTM D 638	1989 Test Method for Tensile Properties of Plastics
ASTM D 696	1991 Test Method for Coefficient of Linear Thermal Expansion of Plastic between 30C and 30C

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATES (NEMA)

NEMA LD3	1991 High Pressure Decorative Laminate

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "SUBMITTAL PROCEDURES".

1.2.1 SD-02, Manufacturer's Catalog Data

a. Solid polymer fabrications G

1.3 QUALITY ASSURANCE

1.3.1 Appearance

Do not change source or supply of materials after work has started if the appearance of the finished work would be affected. Variation of component size and location of openings shall be +/- 3 mm .

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver components and materials to the site undamaged in containers, plainly marked and labeled with manufacturer's name. Store components in dry, weathertight sheds or enclosures. Do not deliver components to the project site until areas are ready for installation. Protect materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.5 WARRANTY

Furnish the solid surfacing material manufacturer's warranty. The warranty shall be for a period of ten years from the date of the Government's acceptance of the work.

PART 2 PRODUCTS

2.1 SOLID POLYMER FABRICATIONS

Provide fabrications of cast, filled polymer, nonporous solid surfacing material composed of homogeneous acrylic and mineral fillers conforming to the performance requirements herein. Material shall not be coated or laminated. Solid surfacing material thickness shall be as indicated. Superficial damage to a depth of .25 mm shall be repairable by sanding or polishing.

2.1.1 Performance Requirements

a. Tensile strength, ASTM D 638: 39 980 KPa minimum.

b. Hardness, ASTM D 785: Barcol Impressor 55 minimum.

c. Flammability, ASTM E 84: Class I/A, flame spread 25 maximum, smoke developed 25 maximum.

d. Thermal expansion, ASTM D 696: .0000414 mm/mm/C maximum.

e. Boiling water resistance, NEMA LD3: No permanent effect.

f. High temperature resistance, NEMA LD3: No permanent effect.

g. Liquid absorption, ASTM D 570 (24 hours): .07 percent maximum.

h. Sanitation, National Sanitation Foundation (NSF): Standard No. 51 rating.

i. Impact resistance, NEMA LD3: 0.225 kg ball drop - 6 mm material, 900 mm drop, no failure; 13 mm material, 3000 mm drop, no failure.

j. Toxicity, Pittsburgh Protocol LC50: 60 grams minimum.

2.1.2 Joint Adhesive

Provide two-part joint adhesive as recommended by the solid polymer fabrication manufacturer to form a strong chemical/mechanical bond.

2.1.3 Sealant

Provide mildew resistant, silicone sealant as recommended by the solid polymer fabrication manufacturer.

2.1.4 Heat Conductive Tape

Provide heat conductive tape as recommended by the solid polymer fabrication manufacturer for use near heat sources.

2.1.5 Mounting Hardware

Provide mounting hardware.

2.1.6 FABRICATIONS

Provide solid polymer fabrications in the sizes, shapes, and colors indicated.

2.1.7 Fabrication requirements

a. Fabricate components to the greatest extent practicable to sizes and shapes indicated, in accordance with approved shop drawings. Fabricate coved backsplashes and sidesplashes with 13 mm radius cove at intersections.

b. Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous, nonporous, and reinforced with strips of solid surfacing material in accordance with the manufacturer's instructions.

c. Cut and finish component edges with clean returns. Edges and corners of solid surfacing fabrications shall be rounded with 13 mm minimum radius. Route radii and contours to template. Provide thickened edges using a minimum of two strips of solid surfacing material mounted to the underside of the fabrication perimeter in accordance with approved shop drawings and manufacturer's instructions. Defective and inaccurate work shall be rejected and repaired.

PART 3 EXECUTION

3.1 INSTALLATION

Deliver fabrications to locations indicated. Assemble and install fabrications complete with accessories and hardware.

3.1.1 Assembly Requirements

a. Install components plumb and level scribed to adjacent finishes, in accordance with approved shop drawings and data.

b. Fasten and support fabrications to walls, brackets, and partitions as indicated. Fasteners shall be appropriate for use with the adjoining construction.

c. Form field joints using manufacturer's recommended adhesive. Joints shall be inconspicuous and nonporous. Keep components and hands clean when forming joints. Seal joints using manufacturer's recommended sealant.

d. Keep components and hands clean during installation. Remove excessive adhesive and sealants. Clean finished surfaces of all dirt and stains.

3.1.2 Protection

Provide protective coverings to prevent physical damage or staining following installation.

-- End of Section --

SECTION 07920

SEALANTS
03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 834	(1991) Latex Sealants
ASTM C 920	(1987) Elastomeric Joint Sealants

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Sealants

b. Primers

c. Bond breakers

d. Backstops

Data for the sealants shall include shelf life, recommended cleaning solvents, and colors.

1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 100 degrees F when sealant is applied.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 F degrees or less than 40 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

ASTM C 834. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent casework, door frames, built-in or or surface-mounted equipment and fixtures and similar items.	As selected
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected
c. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Metal-to-metal joints where sealant is indicated or specified.	As selected

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	As selected
b. Control and expansion joints in floors, and slabs.	As selected

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer for the particular application.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, or masonry,		

JOINT WIDTH	JOINT DEPTH Minimum	Maximum
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.3 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.4 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.5 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

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SECTION 08110

STEEL FRAMES
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100	(1991) Standard Steel Doors and Frames
SDI 105	(1992) Recommended Erection Instructions for Steel Frames

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-02 Manufacturer's Catalog Data

a. Frames G

Submit manufacturer's descriptive literature for frames.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver frames and accessories undamaged and with protective wrappings or packaging. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL FRAMES

ANSI/SDI 100, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners.

2.1.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.1.2 Mullions and Transom Bars

Mullions shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto.

2.1.3 Stops and Beads

Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 300 to 400 mm on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.1.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick.

2.2 FINISHES

2.2.1 Factory-Primed Finish

Unless specified otherwise, phosphate treat and factory prime metal frames as specified in ANSI/SDI 100.

2.3 FABRICATION AND WORKMANSHIP

Finished frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable.

2.3.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.2 PROTECTION

Protect frames from damage. Repair damaged frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of frames thoroughly. Remove mastic smears and other unsightly marks.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
Steel channels	16 gage	1.5 mm
Steel Sheet	23 gage	0.7 mm
	16 gage	1.5 mm
	20 gage	0.9 mm
	18 gage	1.2 mm
Anchor bolts	3/8 inches	10 mm

-- End of Section --

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SECTION 08312

SLIDING METAL DOORS
02/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924	(1995) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Windows

UNDERWRITERS LABORATORIES (UL)

UL 14B	(1993) Sliding Hardware for Standard, Horizontally Mounted Tin-Clad Fire Doors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Sliding Metal Doors G

Drawings including elevations of each door type, details of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of tracks, rollers, power operators, controls, and fittings. A schedule showing the location of each door shall be included with the drawings. Manufacturer's catalog data shall be included.

1.3 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering, with the brands and names clearly marked thereon. Doors shall be stored in an adequately ventilated, dry location that is free from dust, water, or other contaminants and in a manner that permits access for inspection and handling. Doors shall be handled carefully to prevent damage to the faces, edges, and ends. Damaged items that cannot be restored to like-new condition shall be replaced.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.5 OPERATION AND MAINTENANCE MANUALS

Manufacturer's installation, operation, and maintenance instructions for sliding metal doors shall be provided.

PART 2 PRODUCTS

2.1 SLIDING METAL DOORS

Sliding doors shall be of the following types:

2.1.1 Hollow Metal

Hollow metal doors shall be non-rated. Doors shall be flush panel consisting of an insulated core covered on both faces with a bonded steel sheet not lighter than 1.0 mm (20 gauge) and covered on edges with a steel perimeter channel not lighter than 1.3 mm (18 gauge). Doors may be fabricated using several panels, with panel edges encased in a steel channel not lighter than 1.9 mm (14 gauge). Joints in face sheets shall be backed by an interior steel H column and covered with a steel surface applied face plate.

2.1.2 Insulated

Non-labeled insulated doors shall be flush panel consisting of a urethane, polystyrene, or fiberglass insulation core covered on both faces with a bonded steel sheet not lighter than 1.3 mm (18 gauge) and covered on the edges with a steel perimeter channel not lighter than 1.3 mm (18 gauge). Door construction shall provide a thermal conductance (U-value) of 0.85 W/square meter times K (0.15 btu/hr times sq f times f) . Doors may be fabricated using several panels. Panel edges shall be encased in a steel channel not lighter than 1.9 mm (14 gauge). Joints in face sheets shall be backed by an interior steel H column and covered with a steel surface-applied face plate.

2.2 OPERATION

Doors shall be single-slide on level tracks and shall be designed to normally remain in the closed position but permit normal operation for passage. Doors shall be manual operated.

2.3 HARDWARE

Hardware shall conform to NFPA 80, UL 14B and the requirements specified herein. Tracks, roller assemblies, and installation hardware shall be designed to support a dead load equal to 1-1/2 times the weight of the door and attached hardware without deformation that would interfere with the operation of the door. Tracks shall be formed of galvanized G90 steel not lighter than 1.9 mm (14 gauge). Ball or roller bearing wheels or rollers with case hardened races shall be provided on all devices incorporating wheels or rollers. Hardware shall be attached using zinc plated through bolts, nut plates, or similar devices to ensure adequate fastener strength.

Recessed steel pulls shall be provided on both sides of all door leaves.

2.4 ACCESSORIES

2.4.1 Track Hood

Track hood for exterior doors mounted on the exterior face of the wall shall be zinc-coated steel not lighter than 1.3 mm (18 gauge).

2.4.2 Glass Lights

Glass lights shall be of the size indicated, except that in no case shall the size be larger than that permitted by the required fire rating. Glass shall be in accordance with Section 08800, GLAZING.

2.4.3 Weatherstripping

Weatherstripping shall be provided on head, jamb, and sills of exterior doors. Weatherstripping shall be 1.6 mm thick fabric-reinforced neoprene or shall be nylon-brush type, shall have continuous metal retainers and shall be UL listed.

2.4.4 Locking Device

Heavy-duty mortise lockset with cylinder lock.

2.5 FINISH

2.5.1 Steel Surfaces of Exterior Doors

Steel surfaces of exterior doors shall be provided with a galvanized coating. Exposed surfaces shall be provided with a shop-primed finish in addition to the galvanized coating. Galvanizing shall conform to ASTM A 653 or ASTM A 924, coating designation G90, for steel sheets. Prior to receiving primer, all surfaces shall be cleaned and phosphate-treated for maximum paint adherence. Primer shall be metallic oxide or synthetic resin primer of the manufacturer's standard type and shall be applied by dipping or spraying.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with NFPA 80, approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Exterior doors shall be weather tight. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

3.2 FIELD FINISHING

Doors to receive field finish shall be finished in accordance with Section 09900, PAINTS AND COATINGS.

-- End of Section --

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SECTION 08800

GLAZING
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1036	(1991) Flat Glass
ASTM E 774	(1992) Sealed Insulating Glass Units

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA GM	(1997) Glazing Manual
GANA SM	(1990) Sealant Manual

SEALED INSULATING GLASS MANUFACTURERS ASSOCIATION (SIGMA)

SIGMA A1202	(1983) Commercial Insulating Glass Dimensional Tolerances
SIGMA TM-3000	(1990) Vertical and Basic Field Glazing of Organically Sealed Insulating Glass Units
SIGMA TB-3001	(1990) Sloped Glazing of Organically Sealed Insulating Glass Units

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.2.1 SD-06 Instructions

a. Setting and sealing materials

b. Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified. Include cleaning instructions for plastic sheets.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 4 degrees C and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.5 WARRANTY

1.5.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 5-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

PART 2 PRODUCTS

2.1 GLASS

2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in SIGMA A1202. The units shall conform to ASTM E 774, Class A.

2.2.1 Buildings

Provide 13 mm airspace. The inner light shall be ASTM C 1036, Type I, Class 1, Quality q4, 13 mm thick. The outer light shall be ASTM C 1036, Type I, Class 2 (bronze tinted heat absorbing), Quality q4, 13 mm thick.

2.2.2 Low Emissivity Glass

Insulating glass units (IGU) shall have a thin metallic high-transmittance coating applied to the number 3 surface of the unit. The U-value for the IGU shall be no greater than 0.34.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA GM, SIGMA TM-3000, SIGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Elastomeric Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, and with sealants used in manufacture of insulating glass units. Color of sealant shall be white.

2.3.2 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

2.3.3 Sealing Tapes

Preformed, semisolid, polymeric-based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.3.4 Setting Blocks and Edge Blocks

Lead or neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.

2.3.5 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place.

3.2.1 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA TB-3001 and SIGMA TM-3000.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
Glass	1/8 inch	3 mm
	3/16 inch	4.5 mm
	7/32 inch	6 mm
	1/4 inch	6 mm
	3/8 inch	10 mm
Interlayer	0.015 inch	0.38 mm
Glazing Channels	1/4 inch	6 mm

-- End of Section --

****
NOTE: THIS SPECIFICATION SECTION CONTAINS PROPRIETARY REQUIREMENTS
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SECTION 11312

PACKAGE GRINDER PUMP LIFT STATION

09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.3	(1992) Malleable Iron Threaded Fittings Classes 150 and 300
ANSI B16.11	(1996) Forged Steel Fittings, Socket Welded and Threaded
ANSI B31.1	(1996) Process Piping
ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
ANSI/IEEE C37.90	(1989) Relays and Relay Systems Associated with Electric Power Apparatus
ANSI/IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC on Power Circuits

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123/A 123M	(1997; Rev A) Zinc (Hot-Dip Galvanized) Coatings on Products

ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections

AMERICAN WATER WORKS ASSOCIATION (AWWA) PUBLICATIONS

AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids
AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

INSTITUTE OF ELECTRICAL & ELECTRONICS ENGINEERS Inc (IEEE)

IEEE C62.36	(1994) Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993; Rev. 1-4) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

UNDERWRITERS LABORATORIES Inc (UL)

UL 497A	(1996) Secondary Protectors for Communication Circuits
UL 508	(1993; R 1997) Industrial Control Equipment
UL 1449	(1996; R 1998) Safety Transient Voltage Surge Suppressors

1.2 DESCRIPTION OF WORK

The work includes providing submersible sewage grinder pump station and related work. Provide system complete and ready for operations. Grinder pump station system including equipment, materials, installation, and workmanship shall be as specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings G

b. Check valves G

c. Gate valves G

d. Submersible sewage grinder pumps G

e. Pump motor G

f. Flexible flanged coupling G

g. Pump Station Control System G

1.3.2 SD-04, Drawings

a. Pump Station Control System G

1.3.2.1 Pump Station Control System Drawings

Provide the following:

a. Panel arrangement drawings.

b. Detailed schematic wiring and interconnection diagrams including pumps, pump station control panel, communications panel and telephone wiring.

1.3.3 SD-19, Operation and Maintenance Manuals

a. Submersible Sewage Grinder Pumps Data Package 3 G

Include pumps, alarms, and motors. Data for submersible sewage grinder pump station data shall include all information on all equipment, alarm panel and controls, pumps and pump performance curves, and station layout.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials in enclosures or under protective covering. Store rubber gaskets not to be installed immediately under cover, out of direct sunlight. Do not store materials directly on the ground. Keep interior of pipes and fittings free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Provide pressure piping, air release valves, and related accessories for force main piping outside the sewage wet well and valve vault in accordance with Section 02530, "Sanitary Sewerage".

2.1.1 Ductile-Iron Pipe

ANSI/AWWA C151/A21.51, thickness Class 52.

2.1.1.1 Flanged Pipe

AWWA C115/A21.15, ductile iron.

2.1.1.2 Fittings

AWWA C110/A21.10, flanged. Provide flanged joint fittings within wet well and valve vault as indicated. Provide mechanical joint fittings outside valve vault enclosure as indicated. Fittings shall have pressure rating at least equivalent to that of the pipe.

2.1.1.3 Joints

AWWA C115/A21.15 for flanged joints. Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and shall conform to the applicable requirements of ASME/ANSI B16.1, Class 250. Setscrews for setscrewed flanges shall be 1310 MPa tensile strength, heat treated, and zinc-coated steel. Gasket for setscrewed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

2.1.2 Insulating Joints

Provide between pipes of dissimilar metals a rubber gasket or other approved type of insulating joint or dielectric coupling which shall effectively prevent metal-to-metal contact between adjacent sections of piping.

2.1.3 Accessories

Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.

2.1.4 Flexible Flanged Coupling

Provide flexible flanged coupling applicable for sewage as indicated. The flexible flanged coupling shall be designed for a working pressure of 2.41 Mpa.

2.2 VALVES AND OTHER PIPING ACCESSORIES

2.2.1 Gate Valves in Valve Vault

AWWA C500 and AWWA C509. Valves conforming to AWWA C500 shall be outside-screw-and-yoke rising-stem type with double disc gates and flanged ends. Valves conforming to AWWA C509 shall be outside-screw-and-yoke rising-stem type with flanged ends. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall be of one manufacturer.

2.2.2 Check Valves Less Than 100 mm Diameter

Neoprene ball check valve with integral hydraulic sealing flange, designed for a hydraulic working pressure of 1.21 Mpa (175 psi).

2.2.3 Identification Tags and Plates

Provide valves with tags or plates numbered and stamped for their usage. Plates and tags shall be of brass or nonferrous material and shall be mounted or attached to the valve.

2.2.4 Pipe Support

The pipe support shall be schedule 40 galvanized steel piping conforming to ASTM A 53. Provide either ANSI B16.3 or ANSI B16.11 galvanized threaded fittings.

2.2.5 Miscellaneous Metals

Bolts, nuts, washers, anchors, and supports necessary for the installation of equipment shall be stainless steel.

2.2.6 Quick Disconnect System with Hydraulic Sealing Flange

The quick disconnect system shall consist of a steel base plate for supporting the pumps, a hydraulic sealing flange, pump guide rails and the discharge pipe supports. The two guide rails shall be galvanized steel in accordance with ASTM A 123/A 123M. A steel lifting chain shall be provided for raising and lowering the pump in the basin. Guides shall be built onto the pump housing to fit the guide post in order to assure perfect alignment between the pump and guide rails.

2.2.7 Wet Well Vent

Galvanized ASTM A 53 pipe with insect screening.

2.3 SUBMERSIBLE SEWAGE GRINDER PUMPS

Provide submersible sewage pumps with grinder units as shown on the drawings. Provide submersible, centrifugal sewage pumps and grinder units capable of grinding all materials found in normal domestic sewage, including plastics, rubber, sanitary napkins, disposable diapers, and wooden articles into a finely ground slurry with particle dimensions no greater than 6 mm. Pump capacity and motor characteristics as indicated. Design pump to operate in a submerged or partially submerged condition. Provide an integral sliding guide bracket and two guide bars capable of supporting the entire weight of the pumping unit.

2.3.1 Casing

Provide hard, close-grained cast iron casing which is free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. Design casings to permit replacement of wearing parts. Passageways shall permit the smooth flow of sewage and shall be free from sharp turns and projections.

2.3.2 Impeller

Provide non-clogging type cast-iron, or bronze impeller. Make impeller with smooth surfaces, free flowing with the necessary clearance to permit objects in the sewage to pass. Fit and key, spline, or thread impeller on shaft, and lock in such manner that lateral movement will be prevented and reverse rotation will not cause loosening.

2.3.3 Shaft and Shaft Seals

Provide shaft of stainless steel. Provide mechanical seal of double carbon and ceramic construction with mating surfaces lapped to a flatness tolerance of one light band. Hold rotating ceramics in mating position with stationary carbons by a stainless steel spring. Oil lubricate bearings.

2.3.4 Bearings

Provide heavy duty ball thrust bearing or roller type bearing of adequate size to withstand imposed loads. Bearings shall be permanently lubricated.

2.3.5 Pump and Motor

The pump and motor shall be assembled on a single stainless steel shaft in a heavy duty cast-iron shell. The pump support legs shall be free standing cast-iron providing enough clearance for the solids to get into the grinder.

2.4 PUMP MOTOR

Provide submersible sewage pumps in wet well NEMA MG 1, 460 volt, 3 phase, and 60 Hz cycle and for submersible pumps. Motor horsepower shall be not less than pump horsepower at any point on the pump performance curve. Fit motors with lifting "eyes" capable of supporting entire weight of pump and motor.

2.5 PUMP STATION CONTROL SYSTEM

2.5.1 Control Sequence

Control logic shall be executed by a PLC. Alternate pumps 1 and 2 between "Lead Pump" and "Lag Pump" duty after each "All Pumps Off" action. Provide a time delay function such that both sewage pumps can not be started simultaneously for a period of 45 seconds after normal power is restored. Control sequence shall be as follows:

1. Lead Pump ON Float Switch - Start Lead Pump

2. Lag Pump ON Float Switch - Start Lag Pump

3. All Pumps OFF Float Switch - All Pumps Off

2.5.2 Alarm

a. Loss Power as sensed by under voltage relay

b. Pump 1 Flow Fail as sensed by limit switch on check valve

c. Pump 2 Flow Fail as sensed by limit switch on check valve

d. Pump 1 Over Temperature

e. Pump 2 Over Temperature

f. Pump 1 Seal Fail

g. Pump 2 Seal Fail

h. High Level Alarm as sensed by high level float switch

i. Cabinet Low Temperature as sensed by temperature sensor in cabinet

2.5.3 Pump Station Control Panel

Panel assembly and wiring shall comply with NFPA 70 and UL 508 and shall bear a UL label.

2.5.3.1 Programmable Logic Controller

Provide microprocessor based Programmable Logic Controllers (PLCs) each with a Central Processing Unit (CPU) which is programmed via relay ladder logic diagram language. Shall be UL approved.

a. CPU Memory - the memory for the user's application program shall be CMOS RAM. The memory for the system software shall be electrically erasable read-only memory (EEPROM). User memory shall be sized for all control and monitoring functions plus 300 percent spare capacity.

b. Battery Pack-up (Required for RAM Memory) - Provide replaceable battery which shall supply power necessary to maintain the memory for a minimum of 6 months under no power conditions.

c. Power Supply - Power supply shall operate on 120 VAC. Provide circuitry that limits the output current and protects both the load and power supply. Each programmable logic controller (PLC) shall have a dedicated power supply. The power supply shall have provisions for signaling the following conditions: The power supply power source is satisfactory; the CPU is operating properly; the CPU is in run mode; and the battery voltage is low.

d. Communication Port - Provide a communications port to allow programming or operator interface communications via an IBM-compatible personal computer.

e. Discrete Input and Output Modules - Provide discrete input/output modules as necessary to implement all inputs and outputs as required for each PLC. For each type of discrete input and output provided, provide a minimum of five implemented spare discrete inputs and outputs of that type. Each discrete input and output shall have a status indicating LED.

f. Communications Module or Port - Provide a dedicated communications module or port to allow data communications to a remote personal computer (PC) or PLC via a telephone connection using MODBUS communication interface and RTU Protocol.

g. Modem Card - Provide a 33.6 kbps data rate Modem Rackmounted Card or a stand alone model.

h. Handheld Programmer - Shall provide programming, testing and monitoring capability. Provide one handheld programmer to PWC at Building P-1 Norfolk Naval Base and one hand held programmer to PWC Environmental Branch, Building Z-140 Norfolk Naval Base, Norfolk,Virginia. Coordinate with Contracting Officer.

i. Operating Temperature - 0°C to 60°C

2.5.3.2 Horn and Light

Panel shall have a flashing red light and a 150 mm diameter horn. Horn shall emit 120 dB at 1220 mm. Horn and light shall activate during alarm conditions until acknowledged.

2.5.3.3 Heating

Thermostat and heater shall maintain temperature in cabinet at 10°C or higher. A temperature sensor shall trip an alarm when temperature inside panel falls below 5°C.

2.5.3.4 Enclosure

Shall be NEMA 4X stainless steel and shall have an externally operable push to test button for horn and light, and a silence/reset alarm button. It shall also have the following externally visible indicating lights indicating Power On, Pump 1 On, Pump 2 On and each alarm condition.

2.5.3.5 Uninteruptable Power Supply (UPS)

Provide a UPS system for the control power. Shall be suitable for operation in temperature range of 0°C to 40°C and shall be UL listed. The UPS shall be an on-line system and provide continuous, no-break power during complete blackouts or momentary interruptions. Unit shall be sized to carry the load in control panel plus 25% spare capacity for a minimum of 2 hours.

2.5.3.6 Under Voltage Relay

Provide a single phase relay which responds when voltage drops below system voltage. Voltage drop out point shall be adjustable from 70% to 100% of nominal voltage. Time delay shall 150 to 300 milliseconds. Operating temperature shall be -20°C to 65°C. Shall be solid state design and UL recognized. Output relay shall be rated to be suitable for use with PLC discrete input module. Surge withstand rating shall conform to ANSI/IEEE C37.90.

2.5.4 Float Switch Assembly

The sensing devices shall be direct acting float switches consisting of normally-open mercury switches enclosed in a floats. The float assembly shall be pipe mounted. The floats shall be molded of rigid high-density polyurethane foam, color-coded and coated with a durable, water and corrosion-resistant jacket of clear urethane. The connecting cable and support pole shall be provided in accordance with the manufacturers recommendations. A cast aluminum NEMA Type 4 junction box shall be provided to connect the float assembly. The box shall have a gasketed cover with a tapped float fitting and conduit entrance pipe threaded opening. The floats shall be mounted at fixed elevations as shown. When the liquid level being sensed rises or falls past the float, the floats shall tilt and operate their switches.

2.5.5 Central Station

2.5.5.1 Sanitary System (Building P-1)

Provide programming required to add two new pump stations to the existing monitoring program located at building P-1. The existing program was developed using software by Wonder Ware Co. This will include modifications to two existing graphical screens plus the addition of two new graphical screens. The software shall monitor and annunciate all alarm conditions and it shall monitor all pump station operations.

2.5.5.2 Oily Waste System Building (CEP-198)

(1) Communication Panel - Panel assembly and wiring shall comply with NFPA 70 and UL 508 and shall bear a UL label.

NOTICE: PROVIDED LINE DRIVERS AND CARD RACK MUST BE THE FOLLOWING PRODUCT; notwithstanding any other provisions of this solicitation, no product other than ME760C cards and racks manufactured by Blackbox Corp., will be acceptable.

a. Line Drivers - Provide two ME760C cards mounted on a 14-card rack manufactured by Blackbox Corp.

b. Modems - Shall operate at 33.6 kbps, full duplex on circuits in asynchronous or synchronous mode. Modem shall have error correction, auto answer and dial feature, call progress detection and security feature to call back originating number after receiving a call. Modem shall meet the requirements of CCITT for 34 bis modems. Modem shall be capable of operating on unconditional voice grade telephone lines.

c. Connector Blocks - Provide two connector blocks as specified in Section 16721 "Telephone Distribution System".

d. Uninterruptible Power Supply (UPS) - Provide a UPS system for the control power plus the loads of an additional 12 modems and 12 line drivers for a minimum of 2 hours. Shall be suitable for operation in temperature range of 0°C to 40°C. The UPS shall be an on-line system and provide continuous, no-break power during complete blackouts or momentary interruptions. Unit shall be sized to carry the load in control panel.

e. Panel - Panel shall be sized to accommodate all equipment specified plus an additional 12 modems and 12 line drivers.

(2) Programming - Provide programming required to add two new pump stations to the existing monitoring system located at Building C1 294 at DFSP, Craney Island, Portsmouth, Virginia. The system includes an existing PLC manufactured by PLC Direct and a PC with programming developed using software by Wonder Ware Co. Software shall monitor and annunciate all alarms and monitor all pump station operations.

2.5.5.3 Training

Provide training in maintenance and operation of existing software and modifications. Training shall be conducted for 4 individuals and shall be a minimum of 16 hours of training for Building P-1 personnel and 8 hours for Building Z-140 personnel.

2.5.6 Telephone Cabling

Provide as specified in Section 16721 "Telephone Distribution System".

2.5.7 Modem Protector (MP)

Provide transient surge protection to protect each modem from surges that occur on the phone lines. The devices shall be tested to IEEE C62.36 and UL 497A.

(1) Minimum clamping voltage of 105V measured at 2 kV (1.2/50 us) and 1 kA (8/20 us). Time response shall be within 5 nanoseconds.

(2) Shall withstand a minimum surge current of 1.9 kA (8/20 us) at 4 kV.

(3) Operating temperature between - 10°C to 60°C.

(4) Shall have an RJ-11 (4 wire) interface. Provide matching plug for telephone Cable.

(5) Operating voltage capacity shall be 70 VDC minimum.

2.5.8 Surge Protection

Provide a surge protector for each pump station control panel and for communications panel. The devices shall be tested to ANSI/IEEE C62.41 and shall be UL 1449 listed as a transient voltage surge suppressors.

(1) Shall be a hard wired device rated for 120 VAC single phase 60 Hz systems.

(2) Maximum operating voltage 130 VAC.

(3) Minimum clamping voltage of 330V (L-N) and 400V (L-G) measured at 6 kV(1.2/50 us) and 3 kA (8/20 us) combination wave.

(4) Response time of one nanosecond maximum.

(5) Shall withstand a minimum surge correct of 25 kA (8/20 us).

(6) Operating temperature between - 10°C to 60°C

2.5.9 Electrical Requirements

Furnish motors with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall be as specified in Section 16403, "Electrical Distribution System." Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Power wiring and conduit for field installed equipment shall be provided.

2.5.10 Electric Motor

The electric motor shall be hermetically sealed. The power cable shall be sealed inside of the motor end bell. The cable shall be neoprene covered with a flexible metal cover over it for its full length.

2.6 UNDERGROUND EQUIPMENT ENCLOSURE

2.6.1 Access Hatch Cover

Provide aluminum access hatch cover as indicated. The access hatch shall include lifting mechanism, automatic hold open arm, slam lock with handle, and flush lift handle with red vinyl grip. The automatic hold open arm shall lock in the 90 degree position. The cover shall be 6 mm diamond plate with 6 mm channel frame and continuous anchor flange. The access hatch cover shall be capable to withstand a live load of 1500 kg/sq. meter. Provide stainless steel cylinder lock with two keys per lock. Key all the locks the same.

2.6.2 Wet Well and Valve Vault

Provide concrete wet well and Valve Vault with inside diameter as indicated. Precast structures may be provided in lieu of cast-in-place structures.

2.6.2.1 Cast-In-Place Concrete Structures

Provide wet well and valve vault with a compressive strength of 3000 psi at 28 days as specified in Section 03300, "Cast-In-Place Concrete."

2.6.2.2 Precast Concrete Structures

ASTM C 478, except as specified herein. Provide precast concrete structures with a compressive strength of 4000 psi at 28 days and an air entrainment of 6 percent, plus, or minus 2 percent and a minimum wall thickness of 5 inches. ASTM A 615/A 615M reinforcing bars. ASTM C 443 or AASHTO M198, Type B gaskets for joint connections. Base and first riser shall be monolithic.

PART 3 EXECUTION

3.1 INSTALLATION

Provide pump station in accordance with drawings and requirements of the respective equipment manufacturers. Dampen and isolate equipment vibration.

3.1.1 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled, "General Requirements for Installation of Pipelines" of Section 02530, "Sanitary Sewerage", and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

a. Make flanged joint with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange.

3.1.2 Valves

Installation of Valves: Install gate valves conforming to AWWA C500 in accordance with AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves conforming to AWWA C509 in accordance with AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation , except as otherwise indicated. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

3.1.3 Steel Piping

Installation of steel piping shall be in accordance with ANSI B31.1. Jointing compound for pipe threads shall be PTFE pipe thread paste or PTFE powder and oil.

3.1.4 Force Main

Provide in accordance with Section 02530 entitled "Sanitary Sewerage".

3.1.5 Equipment Installation

Install equipment in accordance with these specifications and the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping to avoid imposing stress on any equipment. Match flanges accurately before securing bolts.

3.2 FIELD TESTS AND INSPECTIONS

Perform all field tests, and provide all labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Division 1. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with contract requirements. Allow concrete to cure a minimum of 5 days before testing any section of piping where concrete thrust blocks have been provided.

3.2.1 Testing Procedure

Test piping in accordance with the Section 02530, "Sanitary Sewerage". All equipment shall be tested in operation to demonstrate compliance with the contract requirements.

3.2.2 Sewage Grinder Pump Lift Station

Pumps and controls shall be tested, in operation, under design conditions to insure proper operation of all such equipment. All appliances, materials, water, and equipment for testing shall be provided by the Contractor, and all expenses in connection with the testing shall be borne by him. Testing shall be conducted after all equipment is properly installed, electrical services and piping are installed, liquid is flowing, and the pump station is ready for operation. All defects discovered shall be corrected to the satisfaction of the Contracting Officer, and all tests repeated, at the expense of the Contractor, until the equipment is in proper working order.

-- End of Section --

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SECTION 13111

CATHODIC PROTECTION BY IMPRESSED CURRENT
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1996) Square and Hex Bolts and Screws Inch Series
ANSI C2	(1997) National Electrical Safety Code
ANSI C119.1	(1986, R 1997) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.25	(1997) Buttwelding Ends
ASME/ANSI B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 518M	(1992) Corrosion-Resistant High-Silicon Iron Castings (Metric)
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper

	Conductors, Hard, Medium-Hard, or Soft
ASTM D 1785	(1996; Rev. B) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 3381	(1992) Viscosity-Graded Asphalt Cement for Use in Pavement Construction

MILITARY SPECIFICATIONS (MIL)

MIL-I-1361	(Rev. C) Instrument Auxiliaries, Electrical Measuring: Shunts, Resistors and Transformers

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0169	(1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0285	(1995) Corrosion Control of Underground Storage Tanks Systems by Cathodic Protection
NACE RP0572	(1995) Design, Installation, Operation and Maintenance of Impressed Current Deep Ground beds

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA ST 1	(1988) Specialty Transformers (Except General-Purpose Type)
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 44	(1997; Bul. 1997; R 1998) Thermoset-Insulated Wires and Cables
UL 83	(1996; Bul. 1997, R 1998) Thermoplastic-Insulated Wires and Cables
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment
UL 486A	(1997; R 1998) Wire Connectors and Soldering Lugs for Use with Copper

	Conductors
UL 489	(1991; Bul. 1992, 1993, 1994, and 1996, R 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 506	(1994; R 1997, Bul. 1997) Specialty Transformers
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.2 Related Requirements

Sections 16050, "Basic Electrical Materials and Methods", 16303, "Underground and Underpier Electrical Work", and, 16403, "Electrical Distribution System", apply to this section except as modified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Rectifiers G

b. Cable G

c. Insulating flange sets G

d. Dielectric unions G

e. Anodes G

f. Test stations G

g. Anode junction boxes G

h. Anode vent pipe G

i. Reference electrodes G

j. Shunt resistors G

k. Variable resistors G

l. Anode backfill G

m. Bonding boxes G

n. Surge arrestors G

1.3.2 SD-04 Drawings

a. Rectifiers G

b. Insulating flange sets G

c. Anode installation G

d. Test stations G

e. Bonding boxes G

f. Anode junction boxes G

g. Anode vent pipe G

h. Joint bonds G

1.3.3 SD-08 Statements

a. Qualifications of Corrosion Engineer G

1.3.4 SD-12 Field Test Reports

a. Initial Cathodic Protection System Field Test Report G

b. One Year Warranty Period Cathodic Protection System Field Test Report G

c. Final Cathodic Protection System Field Test Report G

1.3.5 SD-19 Operation and Maintenance Manuals

a. Cathodic protection system, Data Package 5

b. Rectifier replacement/spare parts list, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.4 SERVICES OF CORROSION ENGINEER

The Contractor shall obtain the services of a Corrosion Engineer to supervise, inspect and test the installation of the cathodic protection system. Corrosion Engineer refers to a registered professional engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures. Such a person shall be accredited or certified by the National Association or Corrosion Engineers at the level of Corrosion Specialist or Cathodic Protection Specialist. Such a person shall have not less than five years experience in the cathodic protection of underground or submerged structures. The contractor shall submit evidence of the qualifications of corrosion engineer to the Contracting Officer for review and approval.

PART 2 PRODUCTS

2.1 ANODES

2.1.1 High-Silicon Chromium Bearing Cast Iron

ASTM A 518M. Chemical composition as follows:

Carbon	0.70 - 1.10 percent
Manganese	0.75 percent maximum
Silicon	14.20 - 14.75 percent

Chromium	4.00 - 4.50 percent
Copper	0.50 percent maximum
Molybdenum	0.50 percent maximum
Iron	Remainder

Anode dimensions: Type D anodes to be 51 mm diameter by 1524 mm long and Type E anodes to be 76 mm diameter by 1524 mm long unless otherwise indicated.

Bare anode weight: Type D anodes to be 20 kg Type E anodes to be 49.9 kg unless otherwise indicated.

2.1.2 Anode Lead Wires

Not less than No. 8 AWG stranded copper conductor with 2.8 mm thick high molecular weight polyethylene (HMWPE) insulation, 3050 mmin length for vertical anode bed and of sufficient length to extend to junction box without splicing for deep anode bed.

2.1.3 Attachment of Anode Lead Wire

Anode lead wires shall be factory installed.

2.1.3.1 End Connected Anode

Drill a recess 150 mm deep in one end of the anode. Attach the lead wire to the anode with an anchor device. Not more than 10 mm of bare wire shall protrude from the anchor device. Attachment shall withstand a 1446 Newton pull without loosening the wire or anchor device. Fill the recess with an epoxy sealing compound, leaving sufficient space for a plug. Provide non-metallic plug flush with the anode end surface. Install a heat shrinkable anode cap over the attachment, cap shall extend not less than 65 mm on the lead wire and 75 mm on the anode. Cable to anode contact resistance shall be 0.02 ohms maximum.

2.1.4 Anode Backfill

Calcined petroleum coal coke breeze having the following analysis:

a. Chemical composition -

Fixed carbon	- 99.54 percent
Ash	- 0.10 percent
Moisture content	- 0.00 percent
Volatile matter	- 0.60 percent (maximum)
Remainder	- 0.00 percent

b. Weight: 1184 kg per cubic meter

c. Size: 1 mm maximum diameter.

2.1.5 Gravel

100 percent to pass 25 mm mesh.

2.1.6 Anode Centering Device for Deep Anode Ground Beds

Non-metallic and capable of maintaining centering in the hole without interfering with other anode lead wiring until completion of backfilling operations.

2.1.7 Deep Anode Ground Bed Casing

The casing shall be 200 mm diameter, PVC pipe, conforming to ASTM D 1785.

2.2 ANODE VENT PIPE

NEMA TC 2, Type EPC-80-PVC, 38 mm in diameter and having vertical slits parallel to the pipe longitudinal centerline, 38 mm long, 0.15 mm wide, spaced 152 mm apart longitudinally and 25 mm apart circumferentially around the vent pipe along the length of vent tube which is in the coke breeze backfill.

2.3 RECTIFIERS

2.3.1 Transformer

UL 506 and NEMA ST 1, as applicable.

2.3.2 Electrical Ratings

Electrical ratings as follows: input voltage at 60 Hz: 277 volts single phase.

a. Output voltage, dc: 60 volts

b. Output current, dc: 50 amperes

The rectifier shall be capable of supplying continuous full rated output at an ambient temperature of 44 degrees C in full sunlight with expected life of 10 years minimum.

2.3.3 Rectifier Stacks

Silicon connected in such a manner as to provide full wave rectification.

2.3.4 Enclosure

NEMA ICS 6, Type 4, suitable for wall mounting. Enclosure shall include hinged door with padlock hasp. Fit enclosure with screened openings to provide for cooling by natural convection. Provide holes, conduit knockouts and threaded hubs of sufficient size and location. The cabinet and mounting support shall be hot-dipped galvanized steel according to the manufacturer's standards.

2.3.5 Overload and Short Circuit Protection

UL 489, Molded case circuit breaker, thermal-magnetic type.

2.3.6 D.C. Output Control

D.C. output voltage shall be adjustable. Transformer taps, 5 coarse, 5 fine.

2.3.7 Output Voltage and Current Metering

Provide separate panel voltmeter and ammeter, not less than 63.5 mm rectangular, two percent full scale accuracy at 30 degrees C, temperature stability above and below 30 degrees C of at least one percent per 5 degrees C. Provide an "ON-OFF" toggle switch for each meter.

2.3.8 Surge Protection

Protect silicon diodes by use of AC and DC lightning arresters or metal oxide varistors against overvoltage surges and by current-limiting device against overcurrent surges.

2.3.9 Efficiency

Overall efficiency of 65 percent minimum when operated at full output.

2.3.10 Grounding Provisions

NFPA 70 and UL 467 including a grounding terminal in the cabinet. Grounding conductor from terminal to pier grounding system shall be solid or stranded copper not smaller than No. 6 AWG. Pier grounding system shall consist of ground point located in wall as indicated

2.3.11 Shunt Resistors

MIL-I-1361. Resistors shall be located on the rectifier front panel and clearly marked with current and voltage for verification of panel ammeter.

2.3.12 Wiring Diagram

Provide complete wiring diagram of the power unit showing both A.C. supply and D.C. connections to anodes on the inside of the cabinet door. Show and label components.

2.3.13 Rectifier Replacement/Spare Parts List

Provide identification and coverage for all parts of each component, assembly, and accessory of the items subject to replacement in accordance with Section 01781, "Operation and Maintenance Data."

2.4 CONDUIT AND CABLE FOR POWER SERVICE AT 600 VOLTS OR LESS

2.4.1 Conduit

Provide conduit as indicated in Section 16403, "Electrical Distribution System."

2.4.2 Cable

UL 83, Type THW; UL 44, Type RHW, High Molecular Weight Polyethylene (HMWPE) copper conductors, gage (AWG) as indicated. Copper wires shall conform to ASTM B 3 and ASTM B 8. Lead wires terminating at a junction box or test station shall have a cable identification tag.

2.4.3 Cable Identification Tags

Laminated plastic material with black letters on a yellow background. Print letters and numbers a minimum of 5 mm in size. Provide identifier legend as indicated.

2.4.4 Wire Connectors

UL 486A. Solderless copper crimp connections. Exothermic weld.

2.4.5 Insulating Tape

UL 510.

2.4.6 Underground Splices

Provide splices with a compression connector on the conductor, and insulation and waterproofing using the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.

   (1) Gravity poured method shall employ materials and equipment contained in and approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.

2.4.7 Buried Cable Warning and Identification Tape

Polyethylene tape, manufactured for warning and identification of buried cable and conduit. Tape shall be 75 mm wide, Yellow in color and read "Caution Buried Cable Below" or similar. Color and lettering shall be permanent and unaffected by moisture or other substances in backfilling.

2.5 ANODE JUNCTION BOXES AND TEST STATIONS

2.5.1 Wall Mounted Type

NEMA ICS 6, Type 4 enclosure with stainless steel hinges and latched cover and padlocked hasp. Enclosure shall be of non-metallic construction with terminal board and labeled with nameplate. Provide nameplate in accordance with Section 16050, "General Electrical Materials and Methods". Enclosure mounting shall be as indicated.

2.5.2 Terminal Boards

Provide terminal boards for anode junction boxes, bonding boxes, and test stations made of phenolic plastic 3 mm thick with dimensions as indicated. Insulated terminal boards shall have the required number of terminals (one terminal required for each conductor). Install solderless copper lugs and copper bus bars, shunts, and variable resistors on the terminal board as indicated. Test station terminal connections shall be permanently tagged to identify each termination of conductors (e.g. identify the conductors connected to the protected structure, anodes, and reference electrodes). Conductors shall be permanently identified by means of plastic or metal tags, or plastic sleeves to indicate termination.

2.5.3 Conductor Color Coding

Each conductor shall be color coded as follows:

Anode lead wire	- black
Structure lead wire	- white
Reference electrode lead wire	- red

2.5.4 Shunt Resistors

MIL-I-1361. 0.01 ohm, 8 ampere, accuracy plus or minus one percent, manganin wire type.

2.5.5 Variable Resistors

50 watt, 8 ampere, accuracy plus or minus one percent, slide wire type.

2.5.6 Pavement Insert

Pavement insert shall be a non-metallic flush type test station without terminal board, and shall allow a copper-copper sulfate reference electrode to contact the electrolyte beneath the pavement surface. Provide traffic valve box capable of withstanding H-20 traffic loads.

2.6 INSULATING FLANGE SETS

Provide full-faced gaskets, insulating sleeves and washers, and steel washers. Provide flange sets rated for operation at the rated pressure and temperature of the flanges.

2.6.1 Gaskets

ASME B16.21. Neoprene faced phenolic material for operations at 862 kPa and 232 degrees C.

2.6.2 Insulating Washers and Sleeves

Two sets 3 mm laminated phenolic for operation at 232 degrees C. Insulating washers shall fit within the bolt facing on the flange over the outside of the fabric reinforced sleeves.

2.6.3 Washers

Steel, cadmium plated, to fit within the bolt facing on the flange.

2.7 DIELECTRIC UNIONS

ASME/ANSI B16.39, Class 150 for dimensional, strength, and pressure requirements. Insulation barrier shall limit galvanic current to one percent of the short-circuit current in a corresponding metallic joint. Provide insulating material impervious to oil.

2.8 SURGE ARRESTORS FOR ISOLATING FLANGES AND DIELECTRIC UNIONS

Provide explosion proof surge arrestors across isolating flanges and dielectric unions to maintain grounding of above grade pipelines while isolating the cathodic protection systems for underground pipelines. The surge arrestors shall bolt across flanges separated by insulating gasket kits. The arrestors shall be metal oxide varistor (MOV) type or gaped type and shall be able to withstand and pass at least 100,000 amperes and have a surge life of a minimum of 10,000 occurrences (IEEE 587 Cat A waveform) at not less than 200 amperes. Arresters shall be encapsulated so as to be sealed from the atmosphere. Clamping voltage shall be approximately 100 volts. Maximum sparkover voltage shall not exceed 1.0 kV at 30,000 amps. Wire leads shall be not less than 10 AWG copper and must not exceed 305 mm in length. Temperature range for successful operation shall be approximately from -31 degrees C to +75 degrees C. Mount the arrestor assembly to prevent movement.

2.9 BONDING AND GROUNDING EQUIPMENT

UL 467.

2.10 ELECTRICAL INSULATING COATINGS

Conformable water tight sealant having dielectric strength not less than 15 kV for a 3 mm thick layer.

2.11 PERMANENT REFERENCE ELECTRODES

Permanent reference electrodes shall be saturated gelled copper copper-sulfate specifically manufactured for underground use, 31.75 mm diameter, by 255 mm long. The cell shall be prepackaged by the manufacturer with a backfill material as recommended by the manufacturer. Provide cells with No. 12 AWG, THW cable of sufficient length to extend to the test station without splicing. Reference electrodes shall have 15 year life, minimum, and an accuracy of plus or minus 5 millivolts.

2.12 STEEL FLANGES AND BOLTING

2.12.1 Steel Flanges

ASME/ANSI B16.5 1335 N.

2.12.2 Bolting

ASTM A 307, Grade B for bolts: ASTM A 194/A 194M, Grade 2 for nuts. Dimensions ANSI B18.2.1 for bolts, ASME/ANSI B18.2.2 for nuts. Threads: ASME B1.1, Class 2A fit for bolts, Class 2B fit for nuts. Bolts shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at the roof of the threads.

2.13 EXOTHERMIC WELD KITS

Exothermic weld kits specifically designed by the manufacturer for welding the types of materials and shapes provided.

PART 3 EXECUTION

3.1 ANODE INSTALLATION

ANSI C2 NFPA 70.

3.1.1 Anodes and Lead Wires

Provide anodes and lead wires as follows and in accordance with NACE RP0572.

3.1.1.1 Vertical Anodes

a. Excavation for anodes: Excavate hole to the depth and diameter as indicated.

b. Excavation for wire trench: Excavate lead wire and main feed wire trenches to the depth indicated and not less than 610 mm deep, 150 mm wide.

c. Lifting anodes: Do not lift or support anode by the lead wire. Exercise care to preclude damaging the anode and the lead wire insulation.

d. Installing anodes: Place 305 mm of coke breeze in the hole and tamp well. Center the anode in the hole and place 305 mm of additional coke breeze and tamp well taking care not to strike and damage the anode lead wire. Repeat sequence until coke breeze is 305 mm above the anode. Fill the remaining excavation with soil and tamp.

e. Installing lead wires: Cover the lead and main feeder wire trench bottom with a 75 mm layer of sand or stone free earth. Center wire on the backfill layer. Handle to eliminate damage to the cable and insulation, do not stretch or kink the conductor. Place backfill over wire in layers not exceeding 150 mm deep, compact each layer thoroughly. Do not place tree roots, wood scrap, vegetable matter and refuse in the backfill.

f. Anode lead to main feeder connections: Make connections as follows:

(1) Remove insulation to expose approximately 50 mm of each conductor.

(2) Make connection between conductors using solderless crimp connector or exothermic weld.

(3) Cover connection with pre-manufactured splice kit.

g. Anode junction box. Mark each of the wires terminating in the junction box. Install anode junction box as shown in the drawings.

h. Installing lead wires. Connect anode lead wires to the appropriate terminals in the anode junction box.

3.1.1.2 Deep Well Anode Ground beds

a. Drilling of anode well. Drilling of the anode well shall be accomplished by a qualified well driller. Submit documentation of experience to the Contracting Officer. Drill a hole 200 mm in diameter to the depth indicated using rotary bit equipment designed specifically for this purpose. Select the type and consistency of drilling fluids to be consistent with soil characteristics. The use of temporary well casings may be necessary. Remove all temporary casings upon completion of the installation.

b. Excavation for wire trench. Excavate anode header cable wire trenches to the depth indicated and not less than 610 mm deep, 150 mm wide.

c. Installing anodes. Do not lift or support anode by the lead wire. Exercise care to preclude damaging the anode and the lead wire insulation. Attach the anode centralizers to the anodes. Place the vent pipe in the hole as indicated prior to installing the anodes. Install the anodes in the hole at the depths indicated and supported in place using a method that does not suspend the anodes by the lead wire. Label and coil the excess anode lead wire at the top of the casing.

d. Coke backfill. Pump the coke back fill into the hole through a separate removable tube with the tip at the bottom of the hole. Pumping operations shall be continuous. Maintain a continuous supply of fluidized coke at the pump suction until coke is filled to the top of the hole. Allow the coke to settle for 24 hours. Verify the level of coke and provide additional as necessary until the level of coke is not lower than that indicated in the drawings.

e. Casing. Install well head casing as indicated. Seal the annular space between the casing and earth with cement grout. Fill in the top of the anode as shown on the drawings.

f. Anode hole access box. Place the anode hole access box around the top of the casing, and pour the concrete slab around the box as indicated.

g. Anode junction box. Mark each of the wires terminating in the junction box. Install anode junction box as shown in the drawings.

h. Installing lead wires. Connect anode lead wires to the appropriate terminals in the anode junction box.

i. Anode header cable. Cover the anode header cable trench bottom with a 75 mm layer of sand or stone free earth. Center wire on the backfill layer. Handle cable to prevent damage to the cable and insulation, do not stretch or kink the conductor. Place backfill over wire in layers not exceeding 150 mm deep, compact each layer thoroughly. Do not place tree roots, wood scrap, vegetable matter and refuse in the backfill. Connect the anode header cable to the appropriate terminal in the anode junction box.

3.1.2 Wire-To-Structure Connections

Connect wire-to-structure by use of a exothermic weld kit. Clean the structure surface by scraping, filing or wire brushing to produce a clean, bright surface. Weld connections using the exothermic weld kits in accordance with the kit manufacturer's instructions. Test the integrity of the weld, prior to coating, by striking with a 908 gram hammer. Cover connections and exposed structures with an electrically insulating coating, compatible with existing coating.

3.1.3 Rectifiers

Location and mounting as indicated. Assemble and attach equipment enclosures to wall in accordance with the manufacturer's instructions. Handle wires to prevent stretching or kinking the conductors or damaging the insulation. Use lubricants when pulling wires into conduits. Bond the equipment enclosures to a grounding electrode.

3.1.4 Test Stations

Locate test stations as indicated or as follows:

a. At 18.3 meters intervals.

b. At insulating joints.

c. At both ends of casings.

d. Where the pipe crosses any other metal pipes.

e. Where the pipe connects to an existing old piping system not under cathodic protection.

f. Where the pipe connects to a dissimilar metal pipe.

Do not fill the bottom of the test station with concrete unless otherwise specified. Do not place rubbish, scrap or other debris into the test station.

3.1.5 Permanent Reference Electrodes

Locate permanent reference electrodes as indicated or as follows:

a. At 18.3 meters intervals.

b. Equidistant between anodes.

3.1.6 Bonding Boxes

Provide structure bonding boxes in locations as indicated.

3.1.7 Insulating Flange Sets

Locate insulating flanges on lines entering buildings at least 305 mm above grade or floor level. Cut piping and provide flanges into place. Carefully align flange bolt holes and weld flange to pipe in accordance with ASME B16.25. Electrically isolate pipelines entering buildings from the structure wall either below or above ground with an electrically isolating wall sleeve. Provide insulating flange sets into place without springing or forcing. Carefully install flange bolt sleeves to avoid damage to the sleeves.

3.1.8 Dielectric Unions

Provide insulating unions aboveground or within manholes as indicated. Work piping into place without springing or forcing. Apply joint compound or thread tape to male threads only. Backing off to permit alignment of threaded joints shall not be permitted. Engage threads so that not more than three threads remain exposed.

3.1.9 Joint Bonds

Provide joint bonds on metallic pipe to and across buried flexible couplings, mechanical joints, flanged joints and at joints not welded or threaded to provide electrical continuity. Check and verify adherence of the bond to the substrate for mechanical integrity by striking the weld with a 908 gram hammer.

3.1.10 Casings, Insulation, and Seals

Where the pipeline is installed in a casing under a roadway or railway, insulate the pipeline from the casing, and seal the annular space against intrusion of water.

3.1.11 Reconditioning of Surfaces

3.1.11.1 Restoration of Sod

Restore unpaved surfaces disturbed during the installation of anodes and wires to their original elevation and condition. Preserve sod and topsoil carefully and replace after the backfilling is completed. Where the surface is disturbed in a newly seeded area, re-seed the area with the same quality and formula of seed as that used in the original seeding.

3.1.11.2 Restoration of Pavement

Patch pavement, sidewalks, curbs and gutters where existing surfaces are removed for construction. Saw cut pavement edges. Graded aggregate base course shall have a maximum aggregate size of 35 mm. Prime base course with liquid asphalt, ASTM D 2028, Grade RC-70, prior to paving. Match base course thickness to existing but not less than 150 mm thick. Asphalt aggregate size shall be 12.7 mm, asphalt cement shall conform to ASTM D 3381, Grade AR-2000. Match asphalt concrete thickness to existing but not less than 50 mm thick. Repair portland cement concrete pavement, sidewalks, curbs, and gutters using 20.67 MPa concrete conforming to Section 03300, "Cast-In-Place Concrete". Match existing pavement, sidewalk, curb, and gutter thicknesses.

3.2 FIELD QUALITY CONTROL

Field tests shall be witnessed by the Contracting Officer or his designated representative. Advise the Contracting Officer 5 days prior to performing each field test. Quality control for the cathodic protection system shall consist of the following:

a. Initial field testing by the contractor upon construction

b. Government Field Testing after Contractor initial field test report submission.

c. Warranty period field testing by the Contractor.

d. Final field testing by the contractor after one year of service.

3.2.1 Testing

3.2.1.1 Destructive Testing

Contractor shall perform the tests in the presence of the Contracting Officer. Contractor shall include the cost of an additional anode with the longest lead wire for the destructive test in his bid. One completed anode of each type with lead wires shall be chosen at random for destructive testing and shall be submitted to a static pull test. Anode lead wire connections of anodes shall have sufficient strength to withstand a minimum tensile load of 1335 N. Failure of the test anode to conform to this specification can be cause for rejecting all anodes from the same lot as the test anode. The contractor shall mark all rejected anodes on the ends with a 150 mm high "X" using yellow spray paint. Failed anodes shall be removed from the job site by the end of the day. The contractor shall replace any rejected anodes at his expense. The destructive testing provision shall also apply to replacement anodes as well.

3.2.1.2 Wire for Power Service

Test wire for power service at 600 volts or less to determine that the wiring system and equipment are free from short circuits and grounds by a minimum of two megohms. Perform the test with a megohm meter having a 500-volt rating.

3.2.1.3 Initial Cathodic Protection System Field Testing

The systems shall be tested and inspected by the Contractor's corrosion engineer in the presence of the Contracting Officer's corrosion protection engineer or an approved representative. Record test data, including date, time, and locations of testing and submit report to the Contracting Officer. Contractor shall correct, at his expense, all deficiencies in the materials and installation observed by these tests and inspections. Contractor shall pay for retests made necessary by the corrections. Testing shall include the following measurements:

a. Base potentials: At least one week after backfilling of the pipe, but before energizing of the cathodic protection system, measure the base (native) pipe-to-soil potentials of the pipe. Perform measurements at anode junction boxes, test stations and other locations suitable for test purposes (such as service risers or valves) at intervals not exceeding 30 meters with readings at each end point and the midpoint as a minimum. The locations of these measurements shall be identical to the locations specified for measuring energized pipe-to-soil potentials. Use the same measuring equipment that is specified for measuring protected potential measurements.

b. Permanent reference electrode: Verify calibration of the reference electrode by measuring the potential difference between the permanent reference electrode and an independent (portable) calibrated reference electrode. Potential differences between the two electrodes of the same generic type should not exceed 10 millivolts.

c. Insulation testing: Perform insulation testing at each insulating joint or fitting before and after the cathodic protection system is energized. Before energizing, test using an insulation checker. After energizing, test the insulation by measuring the potential shift on both sides of the insulating joint. This testing shall demonstrate that no metallic contact or short circuit exists between the two insulated sections of the pipe. Report and repair defective insulating fitting at the Contractor's expense.

d. Electrical continuity testing: Perform electrical continuity testing for joint bonded pipe prior to backfilling of the pipe. Circulate current through the pipe and compare the measured resistance to the theoretical resistance of the pipe and bond cables. The resistance measured shall not exceed 150 percent of the theoretical resistance.

e. Rectifier system testing: Upon completion of the installation, energize and adjust each rectifier. Measure D.C. outputs of the rectifier and current outputs of each associated anode bed or anodes at different rectifier settings. Measure the current outputs across the installed shunts. Verify these readings using portable, calibrated meters and shunts. This testing shall demonstrate if the rectifier system is capable of functioning properly as required to provide effective cathodic protection.

f. Pipe casing testing: Before final acceptance of the installation, test the electrical insulation of the carrier pipe from casings and correct any short circuits.

g. Energized potentials: With the entire cathodic protection system put into operation for at least one week, measure pipe-to-soil potentials along the pipeline using a copper/copper sulfate reference electrode and all permanent reference electrodes. The voltmeter utilized should have an input impedance of not less than 10 megohms. The locations of these measurements shall be identical to the locations used for the base potential measurements.

h. Interference testing: Before final acceptance of the installation, perform interference testing with respect to any crossing and nearby foreign pipelines in cooperation with the owner of the related pipelines. The testing shall verify that the subject cathodic protection system does not have a deleterious effect on the foreign pipelines, and vice versa. Prepare a full report of the tests, giving all details.

3.2.1.4 Initial Cathodic Protection System Field Test Report

The contractor shall submit a field test report of the cathodic protection system. All structure-to-electrolyte measurements, including initial potentials and anode outputs, shall be recorded on applicable forms. Identification of test locations, test station and anode test stations shall coordinate with the as-built drawings and be provided on system drawings included in the report. The contractor shall locate, correct, and report to the Contracting Officer any short circuits encountered during the checkout of the installed cathodic protection system.

3.2.1.5 Government Field Testing

The government corrosion engineer, LANTNAVFACENGCOM Code 4042 shall review the Contractor's initial field testing report. Approximately four weeks after receipt of the Contractor's initial test report, the system will be tested and inspected in the Contractor's presence by the government corrosion engineer, LANTNAVFACENGCOM Code 4042. The Contractor shall correct, at his expense, materials and installations observed by these tests and inspections to not be in conformance with the plans and specifications. The Contractor shall pay for all retesting done by the government engineer made necessary by the correction of deficiencies.

3.2.1.6 One Year Warranty Period Testing

The Contractor shall inspect, test, and adjust the cathodic protection system quarterly for one year, 3 interim inspections total, to ensure its continued conformance with the criteria outlined below. The performance period for these tests shall commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer. Copies of the One Year Warranty Period Cathodic Protection System Field Test Report, including field data, and certified by the Contractor's corrosion engineer shall be submitted to the Contracting Officer, the activity, and the government corrosion engineer, LANTNAVFACENGCOM Code 4042.

3.2.1.7 Final Field Testing

Conduct final field testing of the cathodic protection system utilizing the same procedures specified under, "Initial Field Testing of the Galvanic Cathodic Protection Systems". The Contractor shall inspect, test, and adjust the cathodic protection system after one year of operation to ensure its continued conformance with the criteria outlined below. The performance period for these tests shall commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer. Copies of the Final Cathodic Protection System Field Test Report, certified by the Contractor's corrosion engineer shall be submitted to the Contracting Officer and the government corrosion engineer, LANTNAVFACENGCOM Code 4042 for approval, and as an attachment to the operation and maintenance manual in accordance with Section 01781, "Operation and Maintenance Data".

3.2.2 Criteria for Cathodic Protection

Conduct in accordance with NACE RP0169 NACE RP0285. Criteria for determining the adequacy of protection shall be selected by the corrosion engineer as applicable:

a. A negative voltage of at least 0.85 volt as measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the earth. Determination of this voltage is to be made with the protective current applied to the pipeline for a minimum of 24 hours. Voltage drops must be considered for valid interpretation of this voltage measurement. The method of voltage drop consideration shall be identified by the Contractor's corrosion engineer and approved by the Government corrosion engineer.

b. A minimum polarization voltage shift of 100 mV measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the earth. This voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. At the instant the protective current is interrupted ("instant off"), an immediate voltage shift will occur. The voltage reading just after the immediate shift shall be used as the base reading from which to measure the polarization decay. The polarization decay shall be the difference between the base reading and a voltage measurement made 24 hours after the interruption of protective current.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

During the warranty testing and at a time designated by the Contracting Officer, make available the services of a technician regularly employed or authorized by the manufacturer of the Cathodic Protection System for instructing Government personnel in the proper operation, maintenance, safety, and emergency procedures of the Cathodic Protection System. The period of instruction shall be not less than one but not more than two 8-hour working days. Conduct the training at the jobsite or at another location mutually satisfactory to the Government and the Contractor. The field instructions shall cover all of the items contained in the operation and maintenance manual.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The English and metric units for the measurements shown are as follows:

PRODUCTS	ENGLISH UNITS	METRIC UNITS
a. Reference Electrodes		
- Diameter	1 1/4 inches	31.75 mm
- Length	10 inches	255 mm
b. Terminal Board		
(phenolic plastic)	1/8 inch	3 mm
thickness	1/4 inch	6 mm

-- End of Section --

SECTION 13114

DESIGN/BUILD CATHODIC PROTECTION SYSTEMS
11/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C119.1	(1986, R 1997) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME/ANSI B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 518M	(1992) Corrosion-Resistant High-Silicon Iron Castings (Metric)
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 843	(1996) Magnesium Alloy Anodes for Cathodic Protection

MILITARY SPECIFICATIONS (MIL)

MIL-I-1361	(Rev. C) Instrument Auxiliaries, Electrical Measuring: Shunts, Resistors and Transformers

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0169	(1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NEMA ST 1	(1988) Specialty Transformers (Except General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	(1997) Rigid Metal Conduit
UL 44	(1997; Bul. 1997, R 1998) Thermoset-Insulated Wires and Cables
UL 83	(1996; Bul. 1997, R 1998) Thermoplastic-Insulated Wires and Cables
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment
UL 486A	(1997; R 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 489	(1991; Bul. 1992, 1993, 1994, and 1996, R 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 506	(1994; R 1997, Bul. 1997) Specialty Transformers
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; R 1998) Metallic Outlet Boxes
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 854	(1996; Bul. 1997) Service-Entrance Cables

1.2 Related Requirements

Sections 16050, "Basic Electrical Materials and Methods", 16303, "Underground and Underpier Electrical Work",and, 16403, "Electrical Distribution System", apply to this section except as modified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Galvanic Anodes G

b. Impressed Current Anodes G

c. Rectifiers G

d. Cable G

e. Insulating flange sets G

f. Dielectric unions G

g. Test stations G

h. Anode junction boxes G

i. Casing insulators and seals G

j. Reference electrodes G

k. Shunt resistors G

l. Rectifier shunt resistors G

m. Anode backfill G

n. Bonding boxes G

1.3.2 SD-04 Drawings

a. Cathodic Protection Design G

b. Rectifiers G

c. Test stations G

d. Bonding boxes G

e. Anode junction boxes G

f. Insulating flange sets G

g. Joint bonds G

1.3.3 SD-05 Design Data

a. Cathodic protection design G

1.3.4 SD-08 Statements

a. Qualifications of Corrosion Engineer G

1.3.5 SD-12 Field Test Reports

a. Initial Cathodic Protection System Field Test Report G

b. One Year Warranty Period Cathodic Protection System Field Test Report G

c. Final Cathodic Protection System Field Test Report G

1.3.6 SD-19 Operation and Maintenance Manuals

a. Cathodic protection system, Data Package 5

b. Rectifier replacement/spare parts list, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.4 SERVICES OF CORROSION ENGINEER

The Contractor shall obtain the services of a Corrosion Engineer to supervise, inspect and test the installation of the cathodic protection system. Corrosion Engineer refers to a registered professional engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures. Such a person shall be accredited or certified by the National Association or Corrosion Engineers at the level of Corrosion Specialist or Cathodic Protection Specialist. Such a person shall have not less than five years experience in the cathodic protection of underground or submerged structures. The contractor shall submit evidence of the qualifications of corrosion engineer to the Contracting Officer for review and approval.

1.5 CATHODIC PROTECTION DESIGN

The contractor's corrosion engineer shall provide a complete cathodic protection system design for underground heating distribution systems as provided by Section 02553, "Pre-engineered Underground Heat Distribution System." Cathodic protection shall be by galvanic anode or impressed current, as applicable for the site. The design shall include test stations with permanent copper-copper sulfate reference electrodes for system testing and long term monitoring. The cathodic protection system shall be designed in accordance with NACE RP0169.

1.5.1 Galvanic System Design

The minimum acceptable galvanic system design for underground structures shall be galvanic anodes, anode test station for structure-to-anode connection via a shunt and copper-copper sulfate reference electrodes located 305 mm from structure. Galvanic systems shall not be provided when soil resistivities exceed 15,000 ohm-cm at tank, pipe or anode depth. The design shall include:

a. Pre-packaged high potential magnesium anodes connected to the underground structure and associated piping via an anode test station. Direct connection of the galvanic anodes to the underground structure's exterior wall will not be allowed. Anode life to be 15 years minimum.

b. Additional design requirements as indicated herein.

1.5.2 Impressed Current Design

The minimum acceptable impressed current system design for underground structures shall be a fused disconnect switch suppling AC power to a manual rectifier, High Silicon Chromium Bearing Cast Iron (HSCBCI) anodes, test station for structure and reference electrode connections and copper-copper sulfate reference electrodes located 305 mm from structure wall. The design shall include:

a. Fused disconnect switch, wall or post mounted.

b. Manual rectifier, pad, wall or post mounted.

c. HSCBCI anodes located for even distribution of current. Top of anodes to be below centerline of tank or pipelines. Each anode shall be in a coke breeze backfill with not less than 76 mm surrounding coverage. Pre-packaged anodes may be utilized. Minimum anode life to be not less than 15 years.

d. HMWPE insulated conductors for structure lead wire, anode lead wires, and anode header cables.

e. Additional design requirements as indicated herein.

1.5.3 Additional Design Requirements

The cathodic protection system design shall include:

a. Flush mounted and/or post mounted anode test stations, as applicable, for cathodic protection system operation and monitoring.

b. Copper-copper sulfate reference electrodes connected at each test station for system monitoring by the Government. Reference electrodes will be located near the protected structure to minimize IR drop. Provide separate structure lead wire connection for potential monitoring in each test station.

c. Minimum design current requirement to be not less than 20 milliamps per square meter of bare steel. Include estimated initial and final coating efficiencies for current requirement calculations.

d. Provide soil resistivity measurements obtained on site utilizing the Wenner four pin method.

e. Provide all design calculations, assumptions and field measurements with the contractor design drawings.

f. Dielectric isolation of underground structure or pipelines from unprotected pipelines and structures.

g. Exothermic welding of wires to underground structures or pipelines.

h. All underground splices shall be cast epoxy type.

i. Provide cable identification tape 300 mm above direct buried cable or conduit.

j. Provide pavement inserts every 15 meters when underground pipelines are beneath concrete or asphalt pavements.

1.5.4 Design Drawings

The following information should be on the drawings:

a. Locations of the subject pipe or structure and all crossing and nearby underground pipes and structures.

b. Locations of all anodes, rectifiers, power sources and test stations.

c. Locations of all insulating flanges and unions.

d. Installation details of anodes, rectifiers and bond cables.

e. Locations of nearby cathodic protection systems.

f. Electrical single-line diagrams, elevations, limiting dimensions, and equipment ratings which are not covered in the specification.

g. Remote indicating or control requirements.

h. Location and tabulation of all soil resistivity measurements taken for the cathodic protection design.

PART 2 PRODUCTS

2.1 GALVANIC ANODES

2.1.1 Magnesium

ASTM B 843 Chemical composition as follows:

Aluminum	0.05 percent maximum
Manganese	0.05-1.3 percent
Zinc	-0- percent maximum
Silicon	-0- percent maximum
Copper	0.02 percent maximum
Nickel	0.001 percent maximum
Iron	0.03 percent maximum
Other Impurities	0.05 percent each, 0.3 percent maximum total
Magnesium	Remainder

a. Bare anode weight: 7.72 kg, minimum, not including core.

b. Anodes, and anode wire, silver soldered to the core. Insulate soldered connection and recess end of the anode to a 600 volts rating with epoxy and cover the connection with heat shrinkable tubing. Insulating material shall extend over the connection and cover the lead wire insulation by not less than 15 mm.

2.1.2 Anode Wires and Core

2.1.2.1 Anode Lead Wires

UL 83. Type THWN copper conductors, not less than No. 12 AWG, 3050 mm long, minimum, and extend to the accompanying junction box without splicing. Anode lead wire shall be factory installed. Dielectric material shall extend past the connection and cover the lead wire insulation by not less than 15 mm.

2.1.3 Anode Backfill

Chemical composition as follows:

Hydrated gypsum -	75 percent
Bentonite clay -	20 percent

Sodium sulfate - 5 percent

Provide granular backfill with 100 percent passing through a 150 micrometers screen. Provide prepackaged anode in a cloth bag containing the anode and backfill. Center the anode in the firmly packed backfill using spacers. Overall dimensions of the bagged anode shall be in accordance with manufactures recommendations.

2.1.4 Magnesium Ribbon Anodes

Chemical composition as follows:

Aluminum	0.10 percent maximum
Manganese	0.5-1.3 percent
Copper	0.02 percent maximum
Nickel	0.001 percent maximum
Iron	0.03 percent maximum
Other Impurities	0.05 percent each, 0.3 percent maximum total
Magnesium	Remainder

a. Bare Anode Weight: 0.36 kg/meter.

b. Anodes extruded magnesium ribbon with 9.5 mm by 19 mm cross section with a 3 mm diameter iron wire core.

2.2 IMPRESSED CURRENT ANODES

2.2.1 High-Silicon Chromium Bearing Cast Iron

ASTM A 518M. Chemical composition as follows:

Carbon	0.70 - 1.10 percent
Manganese	0.75 percent maximum
Silicon	14.20 - 14.75 percent
Chromium	4.00 - 4.50 percent
Copper	0.50 percent maximum
Molybdenum	0.50 percent maximum
Iron	Remainder

Anode dimensions:

ANODE TYPE	ANODE DIMENSIONS DIAMETER	LENGTH	BARE ANODE WEIGHT
Solid rod cast anodes			
CD	38 mm	1524 mm	11.4 kg
D	51 mm	1524 mm	20.0 kg
M	57 mm	1524 mm	28.6 kg
E	76 mm	1524 mm	49.9 kg
SM	114 mm	1524 mm	99.9 kg
Centrifugally cast tubular anodes with uniform wall thickness			
TACD	56 mm	1524 mm	14.5 kg
TAD	67 mm	1524 mm	20.4 kg
TAM	95 mm	1524 mm	27.2 kg
TAE	121 mm	1524 mm	56.7 kg

ANODE TYPE	ANODE DIMENSIONS DIAMETER	LENGTH	BARE ANODE WEIGHT
TA5	121 mm	2133 mm	49.9 kg
TA5A	121 mm	2133 mm	79.9 kg

2.2.2 Anode Lead Wires

Not less than No. 6 AWG stranded copper conductor with 2.8 mm thick high molecular weight polyethylene (HMWPE) insulation, of sufficient length to extend to junction box without splicing.

2.2.3 Attachment of Anode Lead Wire

Anode lead wires shall be factory installed.

2.2.3.1 End Connected Anode

Drill a recess 150 mm deep in one end of the anode. Attach the lead wire to the anode with an anchor device. Not more than 10 mm of bare wire shall protrude from the anchor device. Attachment shall withstand a 1446 Newton pull without loosening the wire or anchor device. Fill the recess with an epoxy sealing compound, leaving sufficient space for a plug. Provide non-metallic plug flush with the anode end surface. Install a heat shrinkable anode cap over the attachment; cap shall extend not less than 65 mm on the lead wire and 75 mm on the anode. Cable to anode contact resistance shall be 0.02 ohms maximum.

2.2.3.2 Center Connected Anode

Attach the lead wire to the center of the anode with an anchor device suitably fastened to the wire. Not more than 20 mm of bare wire shall protrude from the anchor device. Encapsulate each side of the connection point with high voltage insulating compound mastic and epoxy resin. Attachment shall withstand 4000 N pull without loosening the wire or anchor device. Provide a non-metallic plug flush with the anode end to prevent chaffing of the anode lead wire. Cable to anode contact resistance shall be 0.004 ohms maximum.

2.2.4 Anode Backfill

Calcined petroleum coal coke breeze having the following analysis:

a. Chemical composition -

Fixed carbon	- 99.54 percent
Ash	- 0.10 percent
Moisture content	- 0.00 percent
Sulphur	- 0.00 percent
Volatile matter	- 0.60 percent (maximum)

b. Weight: 1184 kg per cubic meter

c. Size: 1 mm maximum diameter

d. Electrical resistivity: 1 ohm-cm maximum

2.2.5 Gravel

100 percent to pass 25 mm mesh.

2.3 RECTIFIERS

2.3.1 Transformer

UL 506 and NEMA ST 1, as applicable.

2.3.2 Electrical Ratings

Electrical ratings as follows: input voltage at 60 Hz: 115, 208, 277 volts single phase or 208, 460 volts three phase as required.

a. Output voltage, dc: As determined by design.

b. Output current, dc: As determined by design.

The rectifier shall be capable of supplying continuous full rated output at an ambient temperature of 44 degrees C in full sunlight with expected life of 10 years minimum.

2.3.3 Rectifier Stacks

Silicon connected in such a manner as to provide full wave rectification.

2.3.4 Enclosure

NEMA ICS 6, Type 4, suitable for wall or pad mounting. Enclosure shall include hinged door with padlock hasp. Fit enclosure with screened openings to provide for cooling by natural convection. Provide holes, conduit knockouts and threaded hubs of sufficient size and location. The cabinet and mounting support shall be hot-dipped galvanized steel according to the manufacturer's standards.

2.3.5 Overload and Short Circuit Protection

UL 489, Molded case circuit breaker, thermal-magnetic type.

2.3.6 D.C. Output Control

D.C. output voltage shall be adjustable. Transformer taps, 5 coarse, 5 fine.

2.3.7 Output Voltage and Current Metering

Provide separate panel voltmeter and ammeter, not less than 63.5 mm rectangular, two percent full scale accuracy at 30 degrees C, temperature stability above and below 30 degrees C of at least one percent per 5 degrees C. Provide an "ON-OFF" toggle switch for each meter.

2.3.8 Surge Protection

Protect silicon diodes by use of AC and DC lightning arresters or metal oxide varistors against overvoltage surges and by current-limiting device against overcurrent surges.

2.3.9 Efficiency

Overall efficiency of 65 percent minimum when operated at full output.

2.3.10 Grounding Provisions

NFPA 70 and UL 467 including a grounding terminal in the cabinet. Grounding conductor from terminal to earth grounding system shall be solid or stranded copper not smaller than No. 6 AWG. Earth grounding system shall consist of one or more copper clad steel rods. Ground rods shall be a minimum of 2435 mm long.

2.3.11 Rectifier Shunt Resistors

MIL-I-1361. Resistors shall be located on the rectifier front panel and clearly marked with current and voltage for verification of panel ammeter.

2.3.12 Wiring Diagram

Provide complete wiring diagram of the power unit showing both A.C. supply and D.C. connections to anodes on the inside of the cabinet door. Show and label components.

2.3.13 Rectifier Replacement/Spare Parts List

Provide identification and coverage for all parts of each component, assembly, and accessory of the items subject to replacement in accordance with Section 01781, "Operation and Maintenance Data."

2.4 CONDUIT AND CABLE FOR POWER SERVICE AT 600 VOLTS OR LESS

2.4.1 Conduit

UL 6, rigid galvanized steel. Outlet boxes: UL 514A and, Fittings: UL 514B, threaded hubs.

2.4.2 Cable

UL 83, Type THW; UL 44, Type RHW, UL 854, Type USE, High Molecular Weight Polyethylene (HMWPE) copper conductors, gage (AWG) as indicated. Copper wires shall conform to ASTM B 3 and ASTM B 8. Lead wires terminating at a junction box or test station shall have a cable identification tag.

2.4.3 Cable Identification Tags

Laminated plastic material with black letters on a yellow background. Print letters and numbers a minimum of 5 mm in size.

2.4.4 Wire Connectors

UL 486A. Solderless copper crimp connections. Exothermic weld.

2.4.5 Insulating Tape

UL 510.

2.4.6 Underground Splices

Provide splices with a compression connector on the conductor, and insulation and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.

(1) Gravity poured method shall employ materials and equipment contained in and approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.

2.4.7 Buried Cable Warning and Identification Tape

Polyethylene tape, manufactured for warning and identification of buried cable and conduit. Tape shall be 75 mm wide, yellow in color and read "Caution Buried Cable Below" or similar. Color and lettering shall be permanent and unaffected by moisture or other substances in backfilling.

2.5 ANODE JUNCTION BOXES AND TEST STATIONS

2.5.1 Flush Mounted Type

NEMA ICS 6. Metallic or non-metallic with terminal board, minimum of 5 terminal posts and lockable lid. A non-metallic enclosure shall be molded of glass filled polycarbonate with urethane coating or of ABS plastic and mounted on a 500 mm length of PVC conduit. The unit shall be of standard design, manufactured for use as a cathodic protection test station, complete with cover, terminal board, shunts, and brass or 17.7 stainless steel hardware. The terminal board shall be removable for easy access to wires. Provide traffic rated test station capable of withstanding H-20 traffic loads. The cover shall have a cast in legend "CP TEST."

2.5.2 Post Top Mounted Type

NEMA ICS 6. Metallic or non-metallic with terminal board, minimum of 5 terminal posts and a lockable lid. A non-metallic enclosure shall be high impact strength molded plastic. The unit shall be of standard design, manufactured for use as a cathodic protection test station, complete with cover, terminal board, shunts, and brass or 17.7 stainless steel hardware. The terminal board shall be removable for easy access to wires. The test station shall be mounted atop 1830 mm long polyethylene conduit with anchor.

2.5.3 Wall Mounted Type

NEMA ICS 6, Type 4 enclosure with stainless steel hinges and clamped cover. Enclosure shall be of galvanized steel, painted steel, or non-metallic construction with terminal board and labeled with nameplate. Provide nameplate in accordance with Section 16050, "General Electrical Materials and Methods". Enclosure mounting posts shall be steel pipe, schedule 40, wood post, full length pressure treated with pentachlorophenol or as indicated. Mount enclosure 1066 mm above finished grade.

2.5.3.1 Terminal Boards

Provide terminal boards for anode junction boxes, bonding boxes, and test stations made of phenolic plastic 3 mm thick with dimensions as indicated. Insulated terminal boards shall have the required number of terminals (one terminal required for each conductor). Install solderless copper lugs and copper bus bars, shunts, and variable resistors on the terminal board as indicated. Test station terminal connections shall be permanently tagged to identify each termination of conductors (e.g. identify the conductors connected to the protected structure, anodes, and reference electrodes). Conductors shall be permanently identified by means of plastic or metal tags, or plastic sleeves to indicate termination.

2.5.4 Color Coding of Conductors

Each conductor shall be color coded as follows:

Anode lead wire - black
Structure lead wire - white
Reference electrode lead wire - red

2.5.5 Shunt Resistors

MIL-I-1361. 0.01 ohm, 6 ampere, accuracy plus or minus one percent, manganin wire type.

2.5.6 Pavement Insert

Pavement insert shall be a non-metallic flush type test station without terminal board as indicated herein, and shall allow a copper-copper sulfate reference electrode to contact the electrolyte beneath the pavement surface.

2.5.7 Cast-In-Place Concrete

Flush mount type test stations, bonding boxes, and anode junction boxes shall be centered in a 460 x 460 x 102 mm concrete slab. Concrete shall be 20 MPa minimum ultimate 28-day compressive strength with 25 mm minimum aggregate conforming to Section 03300, "Cast-in-place Concrete".

2.6 INSULATING FLANGE SETS

Provide full-faced gaskets, insulating sleeves and washers, and steel washers. Provide flange sets rated for operation at the rated pressure and temperature of the flanges.

2.6.1 Gaskets

ASME B16.21. Neoprene faced phenolic material for operations at 862 kPa and 232 degrees C.

2.6.2 Insulating Washers and Sleeves

Two sets 3 mm laminated phenolic for operation at 232 degrees C. Insulating washers shall fit within the bolt facing on the flange over the outside of the fabric reinforced sleeves.

2.6.3 Washers

Steel, cadmium plated, to fit within the bolt facing on the flange.

2.7 DIELECTRIC UNIONS

ASME/ANSI B16.39, Class 150 for dimensional, strength, and pressure requirements. Insulation barrier shall limit galvanic current to one percent of the short-circuit current in a corresponding metallic joint. Provide insulating material impervious to water.

2.8 BONDING AND GROUNDING EQUIPMENT

UL 467.

2.9 ELECTRICAL INSULATING COATINGS

Heat-shrinkable tape.

2.10 CONCRETE RECTIFIER PAD

Dimensions, conduit locations, and anchor bolt location in accordance with the manufacturer's drawings for the equipment furnished.

2.10.1 Concrete

20.67 MPa concrete conforming to Section 03300, "Cast-In-Place Concrete."

2.11 CASING INSULATORS AND SEALS

Provide in accordance with Section 02553, "Pre-Engineered Underground Heat Distribution System."

2.12 PERMANENT REFERENCE ELECTRODES

Permanent reference electrodes shall be copper/copper-sulfate specifically manufactured for underground use, 31.75 mm diameter, by 255 mm long, plastic tube with an ion trap to minimize contamination of the cell. The cell shall be prepackaged by the manufacturer with a backfill material as recommended by the manufacturer. Provide cells with No. 12 AWG, RHW cable of sufficient length to extend to the test station without splicing. Reference electrodes shall have 15 year life, minimum, and an accuracy of plus or minus 5 millivolts.

2.13 EXOTHERMIC WELD KITS

Provide exothermic weld kits specifically designed by the manufacturer for welding the types of materials and shapes provided.

PART 3 EXECUTION

3.1 CATHODIC PROTECTION SYSTEM INSTALLATION

ANSI C2 and NFPA 70.

3.1.1 Galvanic Anodes and Lead Wires

Provide each anode and lead wires as follows:

a. Excavate hole to a minimum 75 mm larger than the packaged anode diameter, with top of anode 1524 mm deep.

b. Excavate lead wire trench to 610 mm deep, 150 mm wide.

c. Do not lift or support anode by the lead wire. Where applicable, remove manufacturer's plastic wrap/bag from the anode. Exercise care to preclude damaging the cloth bag and the lead wire insulation.

d. Center the packaged anode in the hole with native soil in layers not exceeding 150 millimeters. Hand tamp each layer to remove voids taking care not to strike the anode lead wire. When the backfill is 150 millimeters above the top of the anode, pour not less than ten gallons of water into the hole to saturate the anode backfill and surrounding soil. Anodes shall not be backfilled prior to inspection and approval by the Contracting Officer.

e. Cover the lead wire trench bottom with a 75 mm layer of sand or stone free earth. Center wire on the backfill layer, do not stretch or kink the conductor. Place backfill over wire in layers not exceeding 150 mm deep, compact each layer thoroughly. Do not place tree roots, wood scrap, vegetable matter and refuse in backfill. Place cable warning tape within 450 mm of finished grade, above cable and conduit.

f. Connect anode lead wire(s) to the test station terminal board(s). Allow sufficient slack in the lead wire to compensate for movement during backfilling operation.

g. Clean the structure surface by scraping, filling or wire brushing to produce a clean, bright surface. Weld connections using exothermic kit(s) in accordance with the kit manufacturer's instructions. Check and verify adherence of the bond to the substrate for mechanical integrity by striking the weld with a 908 gram hammer. Cover connections with an electrically insulating coating which is compatible with the existing coating on the structure. Connect structure lead wires to the test station terminal board(s).

3.1.2 Impressed Current Anodes and Lead Wires

Provide anodes and lead wires as follows:

3.1.2.1 Vertical Anodes

a. Excavation for anodes: Excavate hole to a minimum 75 mm larger than the packaged anode diameter and 1830 mm deeper than the structure to be protected.

b. Excavation for wire trench: Excavate lead and main feeder wire trenches to not less than 610 mm deep, 150 mm wide.

c. Lifting anodes: Do not lift or support anode by the lead wire. Exercise care to preclude damaging the anode and the lead wire insulation.

d. Installing anodes: Place 305 mm of coke breeze in the hole and tamp well. Center the anode in the hole and place 305 mm of additional coke breeze and tamp well taking care not to strike and damage the anode lead wire. Repeat sequence until coke breeze is 305 mm above the anode.

e. Installing lead wires: Cover the lead and main feeder wire trench bottom with a 75 mm layer of sand or stone free earth. Center wire on the backfill layer. Handle to eliminate damage to the cable and insulation, do not stretch or kink the conductor. Place backfill over wire in layers not exceeding 150 mm deep, compact each layer thoroughly. Do not place tree roots, wood scrap, vegetable matter and refuse in the backfill.

f. Anode lead to main feeder connections: Make connections as follows:

(1) Remove insulation to expose approximately 50 mm of each conductor.

(2) Make connection between conductors using solderless crimp connector or exothermic weld.

(3) Cover connection with pre-manufactured splice kit.

g. Anode junction box. Mark each of the wires terminating in the junction box. Install anode junction box as shown in the drawings.

h. Installing lead wires. Connect anode lead wires to the appropriate terminals in the anode function box.

3.1.3 Wire-To-Structure Connections

Connect wire-to-structure by use of a exothermic weld kit. Clean the structure surface by scraping, filing or wire brushing to produce a clean, bright surface. Weld connections using the exothermic weld kits in accordance with the kit manufacturer's instructions. Test the integrity of the weld, prior to coating, by striking with a 908 gram hammer. Cover connections and exposed structures with an electrically insulating coating, compatible with existing coating.

3.1.4 Rectifiers

Location and mounting as indicated. Assemble and attach equipment enclosures to wall or pad in accordance with the manufacturer's instructions. Handle wires to prevent stretching or kinking the conductors or damaging the insulation. Use lubricants when pulling wires into conduits. Bond the equipment enclosures to a grounding electrode.

3.1.5 Test Stations

Locate test stations as indicated or as follows:

a. At 18.3 meters intervals.

b. At insulating joints.

c. At both ends of casings.

d. Where the pipe crosses any other metal pipes.

e. Where the pipe connects to an existing old piping system not under cathodic protection.

f. Where the pipe connects to a dissimilar metal pipe.

Do not fill the bottom of the test station with concrete unless otherwise specified. Do not place rubbish, scrap or other debris into the test station.

3.1.6 Permanent Reference Electrodes

Locate permanent reference electrodes as indicated or as follows:

a. At 18.3 meters intervals.

b. Equidistant between anodes.

3.1.7 Bonding Boxes

Provide structure bonding boxes in locations where the protected structure crosses or comes into close proximity to other metal structures that are unprotected or protected by its own electrically isolated cathodic protection system(s).

3.1.8 Insulating Flange Sets

Provide insulating flange sets aboveground or within manholes as required for proper operation of cathodic protection system. Carefully install flange bolt sleeves to avoid damage to the sleeves.

3.1.9 Dielectric Unions

Provide insulating unions aboveground or within manholes as required for proper operation of cathodic protection system. Work piping into place without springing or forcing. Apply joint compound or thread tape to male threads only. Backing off to permit alignment of threaded joints shall not be permitted. Engage threads so that not more than three threads remain exposed.

3.1.10 Joint Bonds

Provide joint bonds on metallic pipe to and across buried flexible couplings, mechanical joints, flanged joints except at places where insulating joints are specified and at joints not welded or threaded to provide electrical continuity. Check and verify adherence of the bond to the substrate for mechanical integrity by striking the weld with a 908 gram hammer.

3.1.11 Casings, Insulation, and Seals

Where the pipeline is installed in a casing under a roadway or railway, insulate the pipeline from the casing, and seal the annular space against intrusion of water.

3.1.12 Reconditioning of Surfaces

3.1.12.1 Restoration of Sod

Restore unpaved surfaces disturbed during the installation of anodes and wires to their original elevation and condition. Preserve sod and topsoil carefully and replace after the backfilling is completed. Where the surface is disturbed in a newly seeded area, re-seed the area with the same quality and formula of seed as that used in the original seeding.

3.1.12.2 Restoration of Pavement

Patch pavement, sidewalks, curbs and gutters where existing surfaces are removed for construction. Saw cut pavement edges. Match existing pavement, sidewalk, curb, and gutter thicknesses.

3.2 FIELD QUALITY CONTROL

Field tests shall be witnessed by the Contracting Officer or his designated representative. Advise the Contracting Officer 5 days prior to performing each field test. Quality control for the cathodic protection system shall consist of the following:

a. Initial field testing by the contractor upon construction

b. Government Field Testing after Contractor initial field test report submission.

c. Warranty period field testing by the Contractor.

d. Final field testing by the contractor after one year of service.

3.2.1 Testing

3.2.1.1 Wire for Power Service

Test wire for power service at 600 volts or less to determine that the wiring system and equipment are free from short circuits and grounds by a minimum of two megohms. Perform the test with a megohm meter having a 500-volt rating.

3.2.1.2 Initial Cathodic Protection System Field Testing

The systems shall be tested and inspected by the Contractor's corrosion engineer in the presence of the Contracting Officer's corrosion protection engineer or an approved representative. Record test data, including date, time, and locations of testing and submit report to the Contracting Officer. Contractor shall correct, at his expense, all deficiencies in the materials and installation observed by these tests and inspections. Contractor shall pay for retests made necessary by the corrections. Testing shall include the following measurements:

a. Base potentials: At least one week after installation of the structure to be protected, but before connecting galvanic systems or energizing impressed current cathodic protection systems, measure the base (native) pipe-to-soil potentials of the pipe and the casings. Perform measurements at anode junction boxes, test stations and other locations suitable for test purposes (such as service risers or valves) at intervals not exceeding 30 meters with readings at each end point and the midpoint as a minimum. The locations of these measurements shall be identical to the locations specified for measuring energized structure-to-electrolyte potentials. Use the same measuring equipment that is specified for measuring protected potential measurements.

b. Permanent reference electrode: Verify calibration of the reference electrode by measuring the potential difference between the permanent reference electrode and an independent (portable) calibrated reference electrode. Potential differences between the two electrodes of the same generic type should not exceed 10 millivolts.

c. Insulation testing: Perform insulation testing at each insulating joint or fitting before and after the cathodic protection system is energized. Before energizing, test using an insulation checker. After energizing, test the insulation by measuring the potential shift on both sides of the insulating joint. This testing shall demonstrate that no metallic contact or short circuit exists between the two insulated sections of the pipe. Report and repair defective insulating fitting at the Contractor's expense.

d. Electrical continuity testing: Perform electrical continuity testing for joint bonded pipe prior to backfilling of the pipe.

e. Galvanic anode-to-soil potentials and galvanic anode outputs: Measure anode-to-soil potential of each anode with the anode disconnected. After connecting the anodes to the pipe, measure current output of each anode across the shunt installed.

f. Rectifier system testing: Upon completion of the installation, energize and adjust each rectifier. Measure D.C. outputs of the rectifier and current outputs of associated ground bed at different rectifier settings. Measure the current outputs across the installed shunts. Verify these readings using portable, calibrated meters and shunts. This testing shall demonstrate if the rectifier system is capable of functioning properly as required to provide effective cathodic protection.

g. Pipe casing testing: Before final acceptance of the installation, test the electrical insulation of the carrier pipe from casings and correct any short circuits.

h. Energized potentials: With the entire cathodic protection system put into operation for at least one week, measure pipe-to-soil potentials along the pipeline and at all casings using a copper/copper sulfate and all permanent reference electrode(s) and a voltmeter having an input impedance of not less than 10 megohms. The locations of these measurements shall be identical to the locations used for the base potential measurements.

i. Interference testing: Before final acceptance of the installation, perform interference testing with respect to any crossing and nearby foreign pipelines in cooperation with the owner of the related pipelines. The testing shall verify that the subject cathodic protection system does not have a deleterious effect on the foreign pipelines, and vice versa. Prepare a full report of the tests, giving all details.

3.2.1.3 Initial Cathodic Protection System Field Test Report

The contractor shall submit a field test report of the cathodic protection system. All structure-to-electrolyte measurements, including initial potentials and anode outputs, shall be recorded on applicable forms. Identification of test locations, test station and anode test stations shall coordinate with the as-built drawings and be provided on system drawings included in the report. The contractor shall locate, correct, and report to the Contracting Officer any short circuits encountered during the checkout of the installed cathodic protection system.

3.2.1.4 Government Field Testing

The government corrosion engineer, LANTNAVFACENGCOM Code 404 shall review the Contractor's initial field testing report. Approximately four weeks after receipt of the Contractor's initial test report, the system will be tested and inspected in the Contractor's presence by the government corrosion engineer, LANTNAVFACENGCOM Code 404. The Contractor shall correct, at his expense, materials and installations observed by these tests and inspections to not be in conformance with the plans and specifications. The Contractor shall pay for all retesting done by the government engineer made necessary by the correction of deficiencies.

3.2.1.5 One Year Warranty Period Testing

The Contractor shall inspect, test, and adjust the cathodic protection system quarterly for one year, 3 interim inspections total, to ensure its continued conformance with the criteria outlined below. The performance period for these tests shall commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer. Copies of the One Year Warranty Period Cathodic Protection System Field Test Report, including field data, and certified by the Contractor's corrosion engineer shall be submitted to the Contracting Officer, the activity, and the geographic Engineering Field Division corrosion engineer, LANTNAVFACENGCOM Code 404.

3.2.1.6 Final Field Testing

Conduct final field testing of the cathodic protection system utilizing the same procedures specified under, "Initial Cathodic Protection System Field Testing". The Contractor shall inspect, test, and adjust the cathodic protection system after one year of operation to ensure its continued conformance with the criteria outlined below. The performance period for these tests shall commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer. Copies of the Final Cathodic Protection System Field Test Report, certified by the Contractor's corrosion engineer shall be submitted to the Contracting Officer and the geographic Engineering Field Division corrosion engineer, LANTNAVFACENGCOM Code 404 for approval, and as an attachment to the operation and maintenance manual in accordance with Section 01781, "Operation and Maintenance Data".

3.2.2 Criteria for Cathodic Protection

Conduct in accordance with NACE RP0169. Criteria for determining the adequacy of protection shall be selected by the corrosion engineer as applicable:

a. A negative voltage of at least 0.85 volt as measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the earth. Determination of this voltage is to be made with the protective current applied to the structure for a minimum of 24 hours. Voltage drops must be considered for valid interpretation of this voltage measurement. The method of voltage drop consideration shall be identified by the Contractor's corrosion engineer and approved by the Government corrosion engineer.

b. A minimum polarization voltage shift of 100 mV measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the earth. This voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. At the instant the protective current is interrupted ("instant off"), an immediate voltage shift will occur. The voltage reading just after the immediate shift shall be used as the base reading from which to measure the polarization decay. The polarization decay shall be the difference between the base reading and a voltage measurement made 24 hours after the interruption of protective current.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

During the warranty testing and at a time designated by the Contracting Officer, make available the services of a technician regularly employed or authorized by the manufacturer of the Cathodic Protection System for instructing Government personnel in the proper operation, maintenance, safety, and emergency procedures of the Cathodic Protection System. The period of instruction shall be not less than one but not more than two 8-hour working days. Conduct the training at the jobsite or at another location mutually satisfactory to the Government and the Contractor. The field instructions shall cover all of the items contained in the operation and maintenance manual.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The English and metric units for the measurements shown are as follows:

	PRODUCTS	ENGLISH UNITS	METRIC UNITS
a.	Reference Electrodes		
	- Diameter	1 1/4 inches	31.75 mm
	- Length	10 inches	255 mm
b.	Terminal Board		
	(phenolic plastic)	1/8 inch	3 mm
	thickness	1/4 inch	6 mm

-- End of Section --

SECTION 13281

ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS
12/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 732	(1995) Aging Effects of Artificial Weathering on Latex Sealants
ASTM D 1331	(1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM E 84	(1995; Rev. B) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 119	(1995; Rev. A) Fire Tests of Building Construction and Materials
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 1368	(1990) Visual Inspection of Asbestos Abatement Projects

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.51	Sanitation
29 CFR 1926.200	Accident Prevention Signs and Tags
29 CFR 1926.59	Hazard Communication
29 CFR 1926.1101	Asbestos, Tremolite, Anthophyllite, Actinolite

40 CFR 61-SUBPART A	General Provisions
40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos Containing Material in Schools

NAVY DIRECTIVES (ND)

ND OPNAVINST 5100.23	(Rev. D) Navy Occupational Safety and Health (NAVOSH) Program Manual

UNDERWRITERS LABORATORIES INC. (UL)

UL 586	(1990) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Asbestos Containing Materials (ACM)

Materials are considered to be asbestos containing if the asbestos content of the material is determined to be greater than one percent of any type or mixture as determined by polarized light microscopy.

1.2.2 Amended Water

Water containing a wetting agent or surfactant with a maximum surface tension of 2.9 Pa when tested in accordance with ASTM D 1331.

1.2.3 Area Sampling

Sampling of asbestos fiber concentrations which approximates the concentrations of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.

1.2.4 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos and any of these minerals that has been chemically treated or altered.

1.2.5 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated by physical boundaries which assist in the prevention of the uncontrolled release of asbestos dust, fibers, or debris.

1.2.6 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5 micrometers as determined by National Institute for Occupational Safety and Health (NIOSH) Method 7400.

1.2.7 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average measured in the breathing zone as defined by 29 CFR 1926.1101 or other Federal legislation having legal jurisdiction for the protection of workers health.

1.2.8 Background

The ambient airborne asbestos concentration in an uncontaminated area as measured prior to any asbestos hazard abatement efforts. Background concentrations for other (contaminated) areas are measured in similar but asbestos free locations.

1.2.9 Competent Person (CP)

A person meeting the requirements for Competent Person as specified in 29 CFR 1926.1101 including a person capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, and is specifically trained in a training course which meet the criteria of EPA's Model Accreditation Plan (40 CFR 763) for project designer or supervisor, or its equivalent.

1.2.10 Contractor

The Contractor is that individual, or entity under contract to the Navy to perform the herein listed work.

1.2.11 Encapsulants

Specific materials in various forms used to chemically or physically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

a. Removal Encapsulant (can be used as a wetting agent)

b. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed).

1.2.12 Friable Asbestos Containing Material

An ACM that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.13 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and/or exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

1.2.14 Navy Consultant (NC)

That qualified person employed directly by the Government to monitor, sample, inspect the work or in some other way advise the Contracting Officer. The NC is normally a private consultant, but can be an employee of the Government.

1.2.15 Negative Pressure Enclosure (NPE)

That engineering control technique described as a negative pressure enclosure in 29 CFR 1926.1101.

1.2.16 Nonfriable Asbestos Containing Material

An ACM in which the fibers have been immobilized by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers may be released under other conditions such as demolition, removal, or mishap.

1.2.17 Non-Regulated Asbestos-Containing Material (Non-RACM)

A non-friable ACM that is not expected to become friable during demolition.

1.2.18 Personal Sampling

Air sampling which is performed to determine asbestos fiber concentrations within the breathing zone of a specific employee, as performed in accordance with 29 CFR 1926.1101.

1.2.20 PCM Refers to Phase Contrast Microscopy

1.2.19 PLM Refers to Polarized Light Microscopy

1.2.20 Private Qualified Person (PQP)

That qualified person hired by the Contractor to perform the herein listed tasks.

1.2.21 Qualified Person (QP)

A Registered Architect, Professional Engineer, Certified Industrial Hygienist, consultant or other qualified person who has successfully completed training and is therefore accredited under a legitimate State Model Accreditation Plan as described in 40 CFR 763 as a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer; and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent. The QP must be qualified to perform visual inspections as indicated in ASTM E 1368.

1.2.22 TEM

Refers to Transmission Electron Microscopy.

1.2.23 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers.

1.2.24 Wetting Agent

A chemical added to water to reduce the water's surface tension thereby increasing the water's ability to soak into the material to which it is applied. An equivalent wetting agent must have a surface tension of at most 2.9 Pa when tested in accordance with ASTM D 1331.

1.3 REQUIREMENTS

1.3.1 Description of Work

The work covered by this section includes the handling and control of asbestos containing materials and describes some of the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of any asbestos containing materials generated by the work. More specific operational procedures shall be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification. The asbestos work includes the removal of the following asbestos-containing and asbestos-contaminated materials located in Buildings Z86 and Z357.

Building Z86:

<u>Material</u>

1. Friable pipe insulation

2. Friable pipe fitting insulation

3. Non-friable floor tile
4. Friable pipe and pipe fitting insulation debris in the crawl space of Building Z86.

5. Asbestos-contaminated carpet

Building Z357:

<u>Material</u>

1. Friable pipe insulation

2. Friable pipe fitting insulation

3. Non-friable floor tile

4. Asbestos-contaminated carpet

Under normal conditions non-friable or chemically bound materials containing asbestos would not be considered hazardous; however, this material may release airborne asbestos fibers during demolition and removal and therefore must be handled in accordance with the removal and disposal procedures as specified herein. Provide negative pressure enclosure as outlined in this specification. Removal of friable ACMs shall be considered OSHA Class I removal work and the removal of non-friable ACMs in a manner that does not render the material friable shall be considered OSHA Class II work. The Navy will evacuate the building before the asbestos abatement work.

The following non-friable non-regulated (NESHAPs, 40 CFR 763 Subpart M) asbestos-containing materials were identified for buildings Z86 and Z357:

Building Z86:

<u>Material</u>

1. Floor tile mastic
2. Roof flashing
3. Sink mastic

Building Z357:

Material

1. Floor tile mastic
2. Sink mastic
3. Built-up roof
4. Roof flashing

These materials are non-friable and are not expected to become friable during the demolition process, and, therefore are considered non-regulated asbestos-containing materials (non-RACMs). The Contractor shall provide an Asbestos Negative Exposure Assessment, in accordance with 29 CFR 1926.1101 (F) (2), indicating that the OSHA PEL was not exceeded and then the non-RACMs can remain and be demolished with the buildings. The demolition of buildings containing non-RACMs shall be considered OSHA Class IV work.

1.3.2 Medical Requirements

Provide medical requirements including but not limited to medical surveillance and medical record keeping as listed in 29 CFR 1926.1101.

1.3.2.1 Medical Examinations

Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent State or local directives. This requirement must have been satisfied within the 12 months prior to the start of work on this contract. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

1.3.2.2 Medical Records

Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of 50 years after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health (OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

1.3.3 Training

Train all personnel involved in the asbestos control work in accordance with United States Environmental Protection Agency (USEPA) Asbestos Hazard Emergency Response Act (AHERA) training criteria or State training criteria whichever is more stringent. The Contractor shall document the training by providing: dates of training, training entity, course outline, names of instructors, and qualifications of instructors upon request by the Contracting Officer. Furnish each employee with respirator training and fit testing administered by the PQP as required by 29 CFR 1926.1101. Fully cover engineering and other hazard control techniques and procedures.

1.3.4 Permits, Licenses, and Notifications

Obtain necessary permits and licenses in conjunction with asbestos removal, encapsulation, hauling, and disposition, and furnish notification of such actions required by Federal, State, regional, and local authorities prior to the start of work. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) and the Contracting Officer in writing 10 working days prior to commencement of work in accordance with 40 CFR 61-SUBPART M.

1.3.5 Environment, Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61-SUBPART A, 40 CFR 61-SUBPART M, and ND OPNAVINST 5100.23. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Government shall apply.

1.3.6 Respiratory Protection Program

Establish and implement a respirator program as required by ANSI Z88.2, 29 CFR 1926.1101, and 29 CFR 1926.103. Submit a written description of the program to the Contracting Officer.

1.3.7 Asbestos Hazard Control Supervisor

The Contractor shall be represented on site by a supervisor, trained using the model Contractor accreditation plan as indicated in the Federal statutes for all portions of the herein listed work.

1.3.8 Hazard Communication

Adhere to all parts of 29 CFR 1926.59 and provide the Contracting Officer with a copy of the Material Safety Data Sheets (MSDS) for all materials brought to the site.

1.4 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Local exhaust equipment G

b. Vacuums G

c. Respirators G

d. Pressure differential automatic recording instrument G

e. Amended water G

f. Glovebags G

g. Material Safety Data Sheets (MSDS) for all materials proposed for transport to the project site G

h. Encapsulants G

1.4.2 SD-08, Statements

a. Asbestos hazard abatement plan G

b. Testing laboratory G

c. Private qualified person documentation G

d. Landfill approval G

e. Employee training G

f. Medical certification requirements G

g. Waste shipment records and if applicable exemption report G

h. Respiratory Protection Program G

i. Hazardous waste manifest G

1.4.2.1 Asbestos Hazard Abatement Plan

Submit a detailed plan of the safety precautions such as lockout, tagout, tryout, fall protection, and confined space entry procedures and equipment and work procedures to be used in the removal of materials containing asbestos. The plan, not to be combined with other hazard abatement plans, shall be prepared, signed, and sealed by the PQP. Provide a Table of Contents for each abatement submittal, which shall follow the sequence of requirements in the contract. Such plan shall include but not be limited to the precise personal protective equipment to be used including, but not limited to, respiratory protection, type of whole-body protection, the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed description of the method to be employed in order to control environmental pollution. The plan shall also include (both fire and medical emergency) response plans. The Asbestos Hazard Abatement Plan must be approved in writing prior to starting any asbestos work. The Contractor, Asbestos Hazard Control Supervisor, and PQP shall meet with the Contracting Officer prior to beginning work, to discuss in detail the Asbestos Hazard Abatement Plan, including work procedures and safety precautions. Once approved by the Contracting Officer, the plan will be enforced as if an addition to the specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan to allow for free discussion and approval by the Contracting Officer prior to starting work.

1.4.2.2 Testing Laboratory

Submit the name, address, and telephone number of each testing laboratory selected for the sampling, analysis, and reporting of airborne concentrations of asbestos fibers along with certification that each laboratory is American Industrial Hygiene Association (AIHA) accredited and that persons counting the samples have been judged proficient by current inclusion on the AIHA Asbestos Analysis Registry (AAR) and successful participation of the laboratory in the Proficiency Analytical Testing (PAT) Program. Where analysis to determine asbestos content in bulk materials or transmission electron microscopy is required, submit evidence that the laboratory is accredited by the National Institute of Science and Technology (NIST) under National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis.

1.4.2.3 Private Qualified Person Documentation

Submit the name, address, and telephone number of the Private Qualified Person (PQP) selected to prepare the Asbestos Hazard Abatement Plan, direct monitoring and training, and documented evidence that the PQP has successfully completed training in and is accredited and where required is certified as, a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer as described by 40 CFR 763 and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent.

1.4.2.4 Landfill Approval

Submit written evidence that the landfill for disposal is approved for asbestos disposal by the USEPA regulatory agency(s). Submit to the Contracting Officer, waste shipment records, prepared in accordance with Federal regulations, signed and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill, within 3 days after delivery. In those States that require a hazardous waste manifest the Contractor shall submit, within 3 days, signed copies of such to the Contracting Officer.

1.4.2.5 Employee Training

Submit certificates, prior to the start of work but after the main abatement submittal, signed by each employee indicating that the employee has received training in the proper handling of materials and wastes that contain asbestos in accordance with 40 CFR 763; understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limits of the respiratory equipment to be used; and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment as indicated in 29 CFR 1926.1101 on an initial and annual basis. Certificates shall be organized by individual worker, not grouped by type of certification.

1.4.2.6 Medical Certification

Provide a written certification for each worker and supervisor, signed by a licensed physician indicating that the worker and supervisor has met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1926.1101 and 29 CFR 1926.103 as prescribed by law. Submit certificates prior to the start of work but after the main abatement submittal.

1.4.2.7 Respiratory Protection Program

Submit a written program manual or operating procedure including methods of compliance with regulatory statutes.

1.4.3 SD-12, Field Test Reports

a. Air sampling results G

b. Pressure differential recordings for local exhaust system G

c. Asbestos disposal quantity report G

d. Clearance sampling G

1.4.3.1 Air Sampling Results

Complete fiber counting and provide results to the PQP for review within 16 hours of the "time off" of the sample pump. Notify the Contracting Officer immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Submit sampling results to the Contracting Officer and the affected Contractor employees where required by law within 3 working days, signed by the testing laboratory employee performing air sampling, the employee that analyzed the sample, and the PQP. Notify the Contractor and the Contracting Officer immediately of any variance in the pressure differential which could cause adjacent unsealed areas to have asbestos fiber concentrations in excess of 0.01 fibers per cubic centimeter or background whichever is higher. In no circumstance shall levels exceed 0.1 fibers per cubic centimeter.

1.4.3.2 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.51 mm of water relative to the pressure external to the enclosure and operate it continuously, 24 hours a day, until the temporary enclosure of the asbestos control area is removed. Submit pressure differential recordings for each work day to the CP for review and to the Contracting Officer within 24 hours from the end of each work day.

1.4.4 SD-18, Records

a. Notifications G

b. Rental equipment G

c. Respirator program records G

d. Permits and licenses G

1.4.4.1 Notifications

Notify the Contracting Officer and other appropriate Government agencies in writing 10 working days prior to the start of asbestos work as indicated in applicable laws, ordinances, criteria, rules, and regulations.

1.4.4.2 Rental Equipment

Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

1.4.4.3 Respirator Program Records

Submit records of the respirator program as required by ANSI Z88.2, 29 CFR 1926.103, and 29 CFR 1926.1101.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Shall conform to current USEPA requirements, shall contain no toxic or hazardous substances as defined in 29 CFR 1926.59, and shall conform to the following performance requirements.

2.1.1 Removal Encapsulants

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96

2.1.2 Lock-down Encapsulant

Requirement	Test Standard
Flame Spread: 25, Smoke Emission - 50	ASTM E 84
Life Expectancy: 20 years	ASTM C 732 Accelerated Aging Test
Permeability: Minimum 0.4 perms	ASTM E 96
Fire Resistance: Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E 119
Bond Strength: 1459 N of force/meter (Tests compatibility with cementitious and fibrous fireproofing)	ASTM E 736

PART 3 EXECUTION

3.1 EQUIPMENT

At all times, provide the Contracting Officer or the Contracting Officer's Representative, with at least two complete sets of personal protective equipment as required for entry to and inspection of the asbestos control area. Provide equivalent training to the Contracting Officer or a designated representative as provided to Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment used to contain airborne asbestos fibers.

3.1.1 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

3.1.1.1 Respirators for Handling Asbestos

Provide personnel engaged in pre-cleaning, cleanup, handling and removal of asbestos materials with respiratory protection as indicated in 29 CFR 1926.1101 and 29 CFR 1926.103.

3.1.2 Exterior Whole Body Protection

3.1.2.1 Outer Protective Clothing

Provide personnel exposed to asbestos with disposable "non-breathable," whole body outer protective clothing, head coverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape.

3.1.2.2 Work Clothing

Provide cloth work clothes for wear under the outer protective clothing and foot coverings and either dispose of or properly decontaminate them as recommended by the PQP after each use.

3.1.2.3 Personal Decontamination Unit

Provide a temporary, negative pressure unit with a separate decontamination locker room and clean locker room with a shower that complies with 29 CFR 1926.51(f)(4)(ii) through (V) in between for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. HEPA vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. Do not wear work clothing between home and work. Locate showers between the decontamination locker room and the clean locker room and require that all employees shower before changing into street clothes. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Dispose of filters and residue as asbestos waste. Discharge clean water to the sanitary system. Dispose of asbestos contaminated work clothing as asbestos contaminated waste. Decontamination units shall be physically attached to the asbestos control area. Build both a personnel decontamination unit and an equipment decontamination unit onto and integral with each asbestos control area.

3.1.2.4 Eye Protection

Provide goggles to personnel engaged in asbestos abatement operations when the use of a full face respirator is not required.

3.1.3 Warning Signs and Labels

Provide warning signs printed in English at all approaches to asbestos control areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

3.1.3.1 Warning Sign

Provide vertical format conforming to 29 CFR 1926.200, and 29 CFR 1926.1101 minimum 500 by 355 mm displaying the following legend in the lower panel:

Legend	Notation
Danger	25 mm Sans Serif Gothic or Block
Asbestos	25 mm Sans Serif Gothic or Block
Cancer and Lung Disease Hazard	6 mm Sans Serif Gothic or Block
Authorized Personnel Only	6 mm Gothic
Respirators and Protective Clothing are Required in this Area	6 mm Gothic

Spacing between lines shall be at least equal to the height of the upper of any two lines.

3.1.3.2 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

BREATHING ASBESTOS DUST MAY

CAUSE SERIOUS BODILY HARM

3.1.4 Local Exhaust System

Provide a local exhaust system in the asbestos control area in accordance with ANSI Z9.2 and 29 CFR 1926.1101 that will provide at least four air changes per hour inside of the negative pressure enclosure. Local exhaust equipment shall be operated 24 hours per day, until the asbestos control area is removed and shall be leak proof to the filter and equipped with HEPA filters. Maintain a minimum pressure differential in the control area of minus 0.51 mm of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument. In no case shall the building ventilation system be used as the local exhaust system for the asbestos control area. Filters on exhaust equipment shall conform to ANSI Z9.2 and UL 586. The local exhaust system shall terminate out of doors and remote from any public access or ventilation system intakes.

3.1.5 Tools

Vacuums shall be leak proof to the filter and equipped with HEPA filters. Filters on vacuums shall conform to ANSI Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse.

3.1.6 Rental Equipment

If rental equipment is to be used, furnish written notification to the rental agency concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

3.1.7 Glovebags

Submit written manufacturers proof that glovebags will not breakdown under expected temperature and conditions.

3.2 WORK PROCEDURE

Perform asbestos related work in accordance with 29 CFR 1926.1101, 40 CFR 61-SUBPART M, and as specified herein. Use wet removal procedures and negative pressure enclosure and glovebag techniques. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum, tobacco, or applying cosmetics shall not be permitted in the asbestos work or control areas. Personnel of other trades not engaged in the removal of asbestos containing material shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection and training provisions of this specification are complied with by the trade personnel. If an asbestos fiber release or spill occurs outside of the asbestos control area, stop work immediately, correct the condition to the satisfaction of the Contracting Officer including clearance sampling, prior to resumption of work.

3.2.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent work. Where such work is damaged or contaminated as verified by the CP or the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust, or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, stop work immediately. Then clean up the spill. When satisfactory visual inspection and air sampling results are obtained from the CP, work may proceed at the discretion of the Contracting Officer.

3.2.2 Furnishings

Furniture and equipment will be removed from the area of work by the Government before asbestos work begins.

3.2.3 Precleaning

Wet wipe and HEPA vacuum all surfaces potentially contaminated with asbestos prior to establishment of an enclosure.

3.2.4 Asbestos Control Area Requirements

3.2.4.1 Negative Pressure Enclosure (OSHA Class I Work)

Block and seal openings in areas where the release of airborne asbestos fibers can be expected. Establish an asbestos negative pressure enclosure with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos work area. Negative pressure enclosure development shall include protective covering of uncontaminated walls, and ceilings with a continuous membrane of two layers of minimum 0.15 mm plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 0.15 mm plastic sheet over floors and extend a minimum of 300 mm up walls. Seal all joints with tape. Provide local exhaust system in the asbestos control area. Openings will be allowed in enclosures of asbestos control areas for personnel and equipment entry and exit, the supply and exhaust of air for the local exhaust system and the removal of properly containerized asbestos containing materials. Replace local exhaust system filters as required to maintain the efficiency of the system.

3.2.4.2 Glovebag

The construction of a negative pressure enclosure is infeasible for the crawlspace of building Z86. Use alternative techniques as indicated in 29

CFR 1926.1101. Establish designated limits for the asbestos regulated area with the use of rope or other continuous barriers, and maintain all other requirements for asbestos control areas. The PQP shall conduct personal samples of each worker engaged in asbestos handling (removal, disposal, transport and other associated work) throughout the duration of the project. If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers at any time exceeds background or 0.01 fibers per cubic centimeter whichever is greater, stop work, evacuate personnel in adjacent areas or provide personnel with approved protective equipment at the discretion of the Contracting Officer. This sampling may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those obtained by the Contractor, the Government will determine which results predominate. If adjacent areas are contaminated as determined by the contracting Officer, clean the contaminated areas, monitor, and visually inspect the area as specified herein.

3.2.4.3 Non-Friable Removal (OSHA Class II)

All work shall be performed inside on asbestos work area. For the asbestos-containing floor tile removal the following practices shall be used:

1. Critical barriers (two layers of 6-mil plastic sheeting) shall be placed over all openings.
2. Enclosure shall be kept under negative pressure by means of a HEPA filtered ventilation unit which shall be exhausted outdoors.
3. HEPA vacuums shall be used.
4. Floor tile shall be removed intact if possible.
5. Floor tile may not be sanded.
6. Dry sweeping is prohibited.
7. Chipping is prohibited unless under negative pressure enclosure (see 3.2.4.1).
8. Intact removal may be performed utilizing dry ice or water.

For the removal of asbestos-containing transite panel the following practices shall be used:

1. A HEPA filtered ventilation unit shall be kept in the work area and exhausted outdoors.
2. HEPA vacuums shall be used.
3. Transite may not be sanded.
4. Dry sweeping is prohibited.
5. Chipping is prohibited unless under negative pressure enclosure (see 3.2.4.1).
6. Transite shall be removed intact.

3.2.4.4 Non-Friable, Non-RACM Removal

An Asbestos Negative Initial Exposure Assessment shall be conducted or provided by the Contractor in accordance with 29 CFR 1926.1101 (f) (2) to evaluate the removal of the non-friable, non-RACM identified in section 1.3.1 and on the drawings. If required, the Asbestos Negative Initial Exposure Assessment shall be conducted as OSHA Class II Work. If the Asbestos Negative Initial Exposure Assessment indicates that employee exposures during the operation are below the permissible exposure limit, then periodic monitoring and work area set up are not required and these materials could remain in the building during demolition. These materials shall be disposed of with the general construction debris at a facility that accepts non-friable, non-RACM.

3.2.5 Removal Procedures

Wet asbestos material with a fine spray of amended water during removal, cutting, or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in 0.15 mm plastic disposal bags. Remove asbestos containing material in a gradual manner, with continuous application of the amended water or wetting agent in such a manner that no asbestos material is disturbed prior to being adequately wetted. Where unusual circumstances prohibit the use of 0.15 mm plastic bags, submit an alternate proposal for containment of asbestos fibers to the Contracting Officer for approval. For example, in the case where both piping and insulation are to be removed, the Contractor may elect to wet the insulation, wrap the pipes and insulation in plastic and remove the pipe by sections. Asbestos containing material shall be containerized while wet. At no time shall asbestos material be allowed to accumulate or become dry. Lower and otherwise handle asbestos containing material as indicated in 40 CFR 61-SUBPART M.

3.2.6 Air Sampling

Sampling of airborne concentrations of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101 and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 shall be performed by the PQP. Sampling performed for environmental and quality control reasons shall be performed by the CP. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government will determine which results predominate.

3.2.6.1 Sampling Prior to Asbestos Work

The CP will provide area air sampling and establish the baseline one day prior to the masking and sealing operations for each removal site. Establish the background by performing area sampling in similar but uncontaminated sites in the building.

3.2.6.2 Sampling During Asbestos Work

The CP shall provide area sampling at least once every work shift close to the work inside the enclosure, outside the clean room entrance to the enclosure, and at the exhaust opening of the local exhaust system. If sampling outside the enclosure shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately.

3.2.6.3 Sampling After Final Clean-Up (Clearance Sampling)

Provide area sampling of asbestos fibers and establish an airborne asbestos concentration of less than 0.01 fibers per cubic centimeter after final clean-up but before removal of the enclosure or the asbestos work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the CP shall perform a visual inspection in accordance with ASTM E 1368 to ensure that the asbestos control and work area is free of any accumulations of dirt, dust, or debris. Perform at least 5 samples. The asbestos fiber counts from these samples shall be less than 0.01 fibers per cubic centimeter or be not greater than the background, whichever is greater. Should any of the final samples indicate a higher value, the Contractor shall take appropriate actions to re-clean the area and shall repeat the sampling and analysis at the Contractor's expense.

3.2.7 Lock-Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, the CP shall conduct a visual inspection of all areas affected by the removal in accordance with ASTM E 1368. Inspect for any visible fibers, and to ensure that encapsulants were applied evenly and appropriately. A post removal (lock-down) encapsulant shall then be spray applied to ceiling, walls, floors and other areas exposed in the removal area. The exposed area shall include but not be limited to plastic barriers, furnishings and articles to be discarded as well as dirty change room, air locks for bag removal and decontamination chambers.

3.2.8 Site Inspection

While performing asbestos engineering control work, the Contractor shall be subject to on-site inspection by the Contracting Officer who may be assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. All related costs including standby time required to resolve the violation shall be at the Contractor's expense.

3.3 CLEAN-UP AND DISPOSAL

3.3.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. DO NOT BLOW DOWN THE SPACE WITH COMPRESSED AIR. When asbestos removal is complete, all asbestos waste is removed from the work-site, and final clean-up is completed, the Contracting Officer will attest that the area is safe before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the enclosure removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper working order. The Contracting Officer will visually inspect all surfaces within the enclosure for residual material or accumulated dust or debris. The Contractor shall re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The Contracting Officer must agree that the area is safe in writing before unrestricted entry will be permitted. The Government shall have the option to perform monitoring to determine if the areas are safe before entry is permitted.

3.3.2 Title to Materials

All waste materials, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable local, State, and Federal regulations and herein.

3.3.3 Disposal of Asbestos

3.3.3.1 Procedure for Disposal

Collect asbestos waste, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiber-proof, waterproof, non-returnable containers (e.g. double plastic bags 0.15 mm thick, cartons, drums or cans). Wastes within the containers must be adequately wet in accordance with 40 CFR 61-SUBPART M. Affix a warning and Department of Transportation (DOT) label to each container including the bags or use at least 0.15 mm thick bags with the approved warnings and DOT labeling preprinted on the bag. The name of the waste generator and the location at which the waste was generated shall be clearly indicated on the outside of each container. Prevent contamination of the transport vehicle (especially if the transport vehicle is a rented truck likely to be used in the future for non-asbestos purposes). These precautions include lining the vehicle cargo area with plastic sheeting (similar to work area enclosure) and thorough cleaning of the cargo area after transport and unloading of asbestos debris is complete. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or State-approved asbestos landfill off Government property. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. Procedure for hauling and disposal shall comply with 40 CFR 61-SUBPART M. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

3.3.3.2 Asbestos Disposal Quantity Report

Direct the PQP to record and report, to the CP and the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear meters or square meters as described initially in this specification and in cubic meters for the amount of asbestos containing material released for disposal.

Allow the CP and/or the Contracting Officer to inspect, record and report the amount of asbestos-containing material removed and released for disposal on a daily basis.

-- End of Section --

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100 % SUBMITTAL
HAZARDOUS MATERIALS REPORT
PIER 2, NAVAL STATION, NORFOLK VIRGINIA
Buildings: Z2, Z86, & Z357

Prepared For:

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, VA 23511-2699

Prepared By:

CAPE
ENVIRONMENTAL
MANAGEMENT
INC
Nationally Recognized by Clients for Superior Service.

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DECEMBER 1998

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1.0 INTRODUCTION

This introductory section briefly describes the project, presents our technical approach to the project, and the sample analysis methodology.

1.1 OVERVIEW

Atlantic Division retained CAPE Environmental Management Inc (CAPE) to prepare hazardous materials abatement documents (technical specifications, plans and cost estimates) for the removal and disposal of asbestos-containing materials (ACM), lead (and Resource Conservation and Recovery Act (RCRA) metals) containing paint, polychlorinated biphenyl (PCB) containing light ballasts and mercury (Hg) containing light tubes from Building Z86, Building Z357 and Building Z2 prior to building demolition.

The following members of CAPE's industrial hygiene and design staff conducted the survey during September of 1998:

- Eric Lynch, EPA-AHERA accredited Asbestos Building Inspector and Project Designer and EPA/TSCA Lead-Based Paint Inspector and Lead Risk Assessor;
- Anthony Allesandrini, EPA-AHERA accredited Asbestos Building Inspector;
- Thomas Gannon, EPA-AHERA accredited Asbestos Building Inspector and EPA/TSCA Lead-Based Paint Inspector;
- Phil Zappley, EPA-AHERA accredited Asbestos Building Inspector and EPA/TSCA Lead-Based Paint Inspector; and
- Brian Davis, EPA-AHERA accredited Asbestos Building Inspector.

1.2 TECHNICAL APPROACH

CAPE conducted an intrusive ACM abatement survey, a lead (and other RCRA metals) containing paint disposal survey and a PCB-containing light ballast and Hg-containing light tube survey to identify materials to be removed before and during building demolition.

CAPE performed the following asbestos abatement services:

1. Verification of previously identified ACMs;
2. Identification of additional accessible and inaccessible suspect ACMs not previously identified;
3. Development of an asbestos sampling plan to confirm non-ACMs previously identified and to sample ACMs not previously identified;

4. Collection of bulk asbestos samples and analysis by polarized light microscopy in accordance with the sampling plan;
5. Confirmation transmission electron microscopy (TEM) analysis of flooring materials determined to be non-ACM by PLM analysis;
6. Quantification of ACMs to be removed before and during demolition;
7. Development of this survey report which includes, asbestos-containing material survey results (see Section 2.0), recommendations and abatement cost estimate (see Section 5.0), asbestos bulk sampling plan and results (see Appendix A), and bulk sample location drawings (see Appendix D) indicating sample locations and analytical results (see Appendix E); and
8. Development of asbestos abatement specifications and abatement drawings for the removal of ACM impacted by the demolition.

The following definitions are provided to explain the categorization of the ACM identified. The definitions include categories of ACMs which must be removed prior to building demolition in accordance with the U.S. EPA, 40 CFR part 61, National Emissions Standards for Hazardous Air Pollutants (NESHAP) Asbestos Revision; Final Rule.

NESHAP Definitions

- **Asbestos-Containing Material (ACM):** Any material containing more than 1% (one percent) of asbestos of any type or mixture as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, Polarized Light Microscopy.
- **Friable ACM -** Any ACM that when dry can be crumbled, pulverized or reduced to a powder by applying hand pressure.
- **Non-Friable ACM -** Any ACM that when dry cannot be crumbled, pulverized or reduced to a powder by hand pressure.
- **Category I Non-Friable ACM:** Asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products containing more than one percent asbestos.
- **Category II Non-Friable ACM:** Any material, excluding Category I Non-Friable ACM, containing more than one percent asbestos that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.
- **Regulated Asbestos Containing Material (RACM):** Any material that meets one or more of the following conditions:
    a) Friable ACM;
    b) Category I Non-Friable ACM that has become friable;
    c) Category I Non-Friable ACM that will be or has been subject to sanding, grinding, cutting, or abrading; or
    d) Category II Non-Friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation.

- **Non-Regulated Asbestos Containing Materials (Non-RACM): Means** Category I ACM or Category II ACM which does not meet the definition stated in RACM condition B, C, or D.

Materials were defined as RACM or Non-RACM based on an interpretation of NESHAP regulations for friable and non-friable ACM and the conditions anticipated during demolition.

Collected asbestos bulk samples were sent to CAPE's laboratory located in Atlanta, Georgia. CAPE's laboratory is accredited by the American Industrial Hygiene Association and participates successfully in the National Voluntary Laboratory Accreditation Program administered by the National Institute of Standards and Technology.

In addition, CAPE performed the following lead (and other RCRA metals) containing paint abatement services:

1. Verification of the presence of lead and testing for the presence of other RCRA metals including arsenic, barium, cadmium, chromium, mercury, selenium and silver in the paint for each painted surface in each building by collecting paint chip samples;
2. Analysis of bulk paint chip samples by atomic absorption spectrophotometry (AAS);
3. Identification of painted building components and their substrates and quantification of the volume of painted building components;
4. Collection of one composite sample to represent the building components in each building;
5. Analysis of the composite sample collected by SW 846 Method 1311 Toxicity Characteristic Leaching Procedure (TCLP) to determine the level of leachable levels of arsenic, barium, chromium, cadmium, lead, mercury, selenium and silver;
6. Based on sample analysis results, determination of whether the demolition debris can be characterized as hazardous or non-hazardous waste due to the presence of leachable levels of arsenic, barium, chromium, cadmium, lead, mercury, selenium or silver in the debris; and
7. Development of this survey report which includes lead and other RCRA metals survey results (see Section 3.0), recommendation and abatement cost estimate (see Section 5.0), AAS analysis results (see Appendix B), TCLP analysis results (see Appendix C), AAS sample analysis reports (see Appendix G) and TCLP sample analysis reports (see Appendix H); and
8. Development of lead (and other RCRA metals) containing paint/building component removal and disposal technical specification (Section 13282), abatement plans and cost estimate.

Collected bulk paint samples were sent to Great Lakes Analytical Laboratories (GLA), King of Prussia, PA and analyzed by Atomic Absorption Spectrophotometry (AAS) in accordance with EPA Method 3050 and 7471. Composite samples of painted building materials were also sent to GLA and analyzed for leachable lead and other RCRA metals in accordance with EPA method SW-846 (TCLP).

CAPE also performed the following PCB-containing light ballast and Hg-containing light tube design services:

1. Quantification and location of PCB-containing light ballasts;
2. Quantification and location of Hg-containing light tubes; and
3. Development of this survey report which includes PCB-containing light ballast and mercury-containing light tube inventory results (see Section 4.0) and recommendation and cost estimate (see Section 5.0); and
4. Development of PCB-containing light ballast and an Hg-containing light tube removal and disposal technical specification (Section 13286), abatement plans and cost estimate.

2.0 ASBESTOS-CONTAINING MATERIAL SURVEY RESULTS

In accordance with the NESHAP regulations, it is recommended that all Regulated Asbestos- Containing Material (RACM) friable, and all Category I and Category II non-friable ACMs which are expected to become friable during demolition activities be removed before demolition. Certain Category I and Category II non-friable ACMs not expected to become friable during demolition activities (i.e., mastics) can remain in the buildings during demolition.

2.0.1 Building Z86

The field investigations of Building Z86 consisted of surveying the crawl space, first floor, second floor and the exterior of the building. The survey involved destructive investigation as necessary to inspect suspect materials not readily accessible.

Based on the field investigations and sample analysis results, the following accessible and inaccessible ACMs were identified and based on expected impact from demolition, classified as RACM or Non-RACM:

1. RACM Friable aircell pipe insulation outer diameter <102mm;
2. RACM Friable aircell pipe insulation outer diameter >102mm;
3. RACM Friable magnesia pipe and pipe fitting insulation outer diameter <102mm;
4. RACM Friable pipe fitting insulation on fiberglass insulated piping outer diameter <102mm;
5. RACM Category I Non-Friable white with brown speckles 12" x 12" floor tile;
6. RACM Category I Non-Friable white with brown streaks 12" x 12" floor tile;
7. RACM Category I Non-Friable tan with black streaks 12" x 12" floor tile;
8. RACM Category I Non-Friable olive with green streaks 12" x 12" floor tile;
9. RACM Category I Non-Friable brown 9" x 9" floor tile;
10. Non-RACM Category I Non-Friable black roof flashing;
11. Non-RACM Category II Non-Friable floor tile mastic; and
12. Non-RACM Category II Non-Friable black sink mastic.

During demolition it is anticipated that the RACM described above will become friable. See Appendix A for a summary of suspect ACM sampled in Building Z86.

2.0.2 Building Z357

The field investigations of Building Z357 consisted of surveying the first floor, second floor and the exterior of the building. The survey involved destructive investigation as necessary to inspect suspect materials not readily accessible.

Based on the field investigations and sample analysis results, the following accessible and inaccessible ACMs were identified and based on expected impact from demolition, classified as RACM or Non-RACM:

1. RACM Friable magnesia pipe and pipe fitting insulation outer diameter <102mm;
2. RACM Friable aircell pipe insulation outer diameter <102mm;
3. RACM Friable pipe fitting insulation on aircell pipe insulation outer diameter <102mm;
4. RACM Category I Non-Friable gray 9” x 9” floor tile;
5. RACM Category I Non-Friable green 9” x 9” floor tile;
6. RACM Category I Non-Friable light green 12” x 12” floor tile;
7. RACM Category I Non-Friable olive 12” x 12” floor tile;
8. Non-RACM Category II Non-Friable floor tile mastic;
9. Non-RACM Category I Non-Friable built-up roof;
10. Non-RACM Category I Non-Friable roof flashing;
11. Non-RACM Category II Non-Friable white sink mastic; and
12. Non-RACM Category II Non-Friable black mastic on fiberglass duct insulation.

During demolition it is anticipated that the RACMs as described above will become friable. See Appendix A for a summary of suspect ACM sampled in Building Z357.

2.0.3 Building Z2 and Pier

The field investigations of Building Z2 and the pier consisted of surveying Bays 1, 2, 3 and 4, the exterior of the building, and underneath the pier. The survey involved destructive investigation as necessary to inspect suspect materials not readily accessible.

Based on the field investigations and sample analysis results, the following accessible and inaccessible ACMs were identified and based on expected impact from demolition, classified as RACM or Non-RACM:

1. Friable RACM aircell pipe insulation outer diameter <102mm;
2. Friable RACM magnesia pipe and pipe fitting insulation outer diameter <102mm;
3. Friable RACM pipe fitting insulation on aircell pipe insulation outer diameter <102mm;
4. Friable RACM pipe fitting insulation on fiberglass pipe insulation outer diameter <102mm;
5. RACM Category I Non-friable white 12” x 12” floor tile;
6. RACM Category I Non-Friable brown 9” x 9” floor tile;
7. RACM Category I Non-Friable green 9” x 9” floor tile;
8. RACM Category I Non-Friable black 9” x 9” floor tile;
9. RACM Category II Non-Friable transite panels;
10. Non-RACM Category II Non-friable floor tile mastic; and
11. Non-RACM Category II Non-Friable window putty.

During demolition it is anticipated that the RACMs as described above will become friable. See Appendix A for a summary of suspect ACM sampled in Building Z2.

3.0 LEAD (AND OTHER RCRA METALS) CONTAINING PAINT SURVEY RESULTS

The objective of the lead (and other RCRA metals) containing paint disposal survey was to confirm the presence of lead and to test for the presence of the following RCRA metals: arsenic, barium, cadmium, chromium, mercury, selenium and silver (and other RCRA metals).

The objective of the composite sampling of painted building components found throughout each building was to determine whether these building components should be disposed of as hazardous or non-hazardous waste. A solid waste (including liquids) is considered hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity above levels established by RCRA. The painted building components should be disposed of as hazardous waste if the Toxicity Characteristic Leaching Procedure (TCLP) sample analysis results indicate that lead or other heavy metal concentrations exceed any of the following levels: Arsenic (5.0 mg/L), Barium (100.0 mg/L), Chromium (5.0 mg/L), Cadmium (1.0 mg/L), Lead (5.0 mg/L), Mercury (0.002 mg/L), Selenium (1.0 mg/L) and Silver (5.0 mg/L).

3.0.1 Building Z86

The field investigation of Building Z86 consisted of surveying the first floor, second floor and building exterior for painted building components. Painted building components identified and sampled included metals, concrete, plaster, wood and brick. Laboratory analysis of bulk paint chip samples by AAS detected the presence of lead, arsenic, barium, cadmium, chromium, mercury, and selenium on the following painted surfaces: metal, concrete, plaster, wood, and brick painted surfaces in this building. Laboratory analysis also detected the presence of silver on metal, concrete and plaster surfaces. See Appendix B for a summary of AAS analysis results.

The Toxicity Characteristic Leaching Procedure (TCLP) composite building components sample analysis results for Building Z86 did not indicate lead or other heavy metal concentrations exceeding hazardous waste levels. Consequently, interior and exterior painted building components can be demolished with the building and disposed of as general construction debris. See Appendix C for a summary of TCLP analysis results.

3.0.2 Building Z357

The field investigation of Building Z357 consisted of surveying the first floor, second floor and building exterior for painted building components. Painted building components identified and sampled included metals, concrete, gypsum and wood. Laboratory analysis of bulk paint chip samples by AAS detected the presence of lead, arsenic, barium, cadmium, chromium and mercury on metal painted surfaces. Lead, arsenic, barium, cadmium, chromium, mercury, and silver were detected on concrete painted building components. Lead, arsenic, barium, chromium, mercury and silver were detected on gypsum painted building components. Lead, barium, chromium, mercury and selenium were detected on wood painted building components. Laboratory analysis also confirmed the presence of silver on metal, concrete and plaster building components. See Appendix B for a summary of AAS analysis results.

The Toxicity Characteristic Leaching Procedure (TCLP) composite building component sample analysis results for Building Z357 did not indicate lead or other heavy metal concentrations exceeding hazardous waste levels. Consequently, interior and exterior painted building components can be demolished with the building and disposed of as general construction debris. See Appendix C for a summary of TCLP analysis results.

3.0.3 Building Z2 and Pier

The field investigation of Building Z2 and the pier consisted of surveying bay 1, bay 2, bay 3, the building exterior, and the pier for painted building components. Painted building components identified and sampled included metals, plaster, concrete, cinder block and wood. Laboratory analysis of bulk paint chip samples by AAS detected the presence of lead on the following painted building components: plaster, wood, metal and concrete. Also, laboratory analysis of bulk paint chip samples by AAS detected the presence of arsenic, barium, cadmium, chromium and mercury on wood and metal painted building components. Arsenic, barium, cadmium, and chromium were detected on concrete and cinder block painted building components, and barium, cadmium and chromium were detected on plaster painted building components. See Appendix B for a summary of AAS analysis results.

The Toxicity Characteristic Leaching Procedure (TCLP) composite building component sample analysis results for Building Z2 did not indicate lead or other heavy metal concentrations exceeding hazardous waste levels. Consequently, interior and exterior painted building components can be demolished with the building and disposed of as general construction debris. See Appendix C for a summary of TCLP analysis results.

4.0 PCB-CONTAINING LIGHT BALLAST AND MERCURY-CONTAINING LIGHT TUBE INVENTORY RESULTS

The objective of the PCB-containing light ballast and Hg-containing light tube design survey was to determine their quantity and location for each building in order to develop a removal and disposal technical specification, plans and cost estimate. The Toxic Substances Control Act (TSCA) requires the EPA to regulate the use and disposal of PCBs, while the Resource Conservation and Recovery Act (RCRA) requires the EPA to regulate the use and disposal of Hg-containing light tubes.

4.0.1 Building Z86

The field investigation of Building Z86 consisted of surveying the first and second floor of the building in order to quantify and note the location of PCB-containing light ballasts and Hg-containing light tubes. A total of five PCB-containing light ballasts were identified in the first floor men's room. Four of the five PCB-containing light ballasts were observed on two ceiling mounted strip fluorescent lighting fixtures, and one PCB-containing light ballast was observed on a wall-mounted fluorescent lighting fixture. Hg-containing light tubes were observed throughout this building.

4.0.2 Building Z357

The field investigation of Building Z357 consisted of surveying the first and second floor of the building in order to quantify and note the location of PCB-containing light ballasts and Hg-containing light tubes. All light ballasts observed in this building were electronic ballasts labeled "No PCBs". Hg-containing light tubes were observed throughout this building.

4.0.3 Building Z2

The field investigation of Building Z2 consisted of surveying Bays 1, 2, 3 and 4 of the building in order to quantify and note the location of PCB-containing light ballasts and Hg-containing light tubes. A total of thirty-four PCB-containing light ballasts were observed in Bay 1 of this building (nineteen in Bay 1-south office area and fifteen in Bay 1-north office area). All of the PCB-containing light ballasts were inside pendant ceiling mounted fluorescent lighting fixtures. Each pendant ceiling mounted fluorescent lighting fixture contained one PCB-containing light ballast and four Hg-containing light tubes. A total of one hundred and thirty-six potential Hg-containing light tubes were also observed in Bay 1 of this building (seventy-six in Bay 1-south office area and sixty in Bay 1-north office area).

APPENDIX A
Asbestos Bulk Sampling Plan and Results

ASBESTOS SAMPLING PLAN AND RESULTS FOR BUILDING Z86

HA #	Description	Location	Previously Identified as a Suspect ACM Yes/No	Previously Sampled Yes/No	# of Samples Previously Collected	# of Samples CAPE Collected	ACM Yes/No
01	12" x 12" white with brown speckles floor tile and mastic	Throughout 1st floor	N	N	0	3	T-Y M-Y
02	9" x 9" brown floor tile and mastic	1st floor classroom. under HA# 1 & offices across classroom. Under HA# 3	Y	Y	1	3	T-Y M-Y
03	12" x 12" white with brown streaks floor tile and mastic	1st floor offices across classroom	Y	Y	1	3	T-Y M-Y
04	12" x 12" tan with black streaks floor tile and mastic	1st floor admin. Reception area & throughout 2nd floor	N	N	0	3	T-Y M-Y
05	12" x 12" olive with green streaks floor tile and mastic	1st floor vending machine area	N	N	0	3	T-Y M-N
06	12" x 12" tan with brown speckles floor tile and mastic	PACE	N	N	0	3	T-N M-N
07	12" x 12" off-white with green streaks floor tile and mastic	PACE	N	N	0	3	T-N M-N
08	Brown stair tread and glue	1st floor & 2nd floor west stairwell	N	N	0	3	N
09	2' x 4' fissured ceiling tile	Throughout 1st & 2nd floor	N	N	0	3	N
10	2' x 2' fissured ceiling tile	1st floor west stairwell	Y	Y	1	3	N
11	Black sink mastic	2nd floor break area	N	N	0	3	Y
12	Pipe fittings on <4" fiberglass, magnesia and aircell piping insulations	1st floor above ceiling tile in admin. Corridor & crawl space	Y	Y	1	3	Y
13	VOID						
14	<4" magnesia pipe insulation	1st floor above ceiling tile in admin. corridor	N	N	0	3	Y
15	Red duct caulking	1st floor transformer room	N	N	0	3	N
16	White mastic on fiberglass ducting	Throughout 1st & 2nd floor	N	N	0	3	N
17	White canvas tape on duct seams	Transformer room	N	N	0	3	N
18	Black vibration gasket	Transformer room	N	N	0	3	N
19	Door & window caulking	Throughout	N	N	0	3	N
20	Black built-up roofing	Roof	Y	N	0	3	N
21	Black roof flashing	Roof	N	N	0	3	Y
22	White gypsum wall	Throughout	N	N	0	3	N
23	White plaster wall	Throughout	N	N	0	3	N
24	White plaster ceiling	Throughout	N	N	0	3	N
25	>4" aircell pipe insulation	Crawlspace	N	N	0	3	Y
26	<4" aircell pipe insulation	Crawlspace	Y	Y	1	3	Y
27	Press cardboard duct insulation with black mastic	2nd floor	N	N	0	3	N
28	1' x 1' white wall tile	1st floor test office and classroom	N	N	0	3	N

Note: T = Floor Tile, M = Mastic, N = No, Y = Yes

ASBESTOS SAMPLING PLAN AND RESULTS FOR BUILDING Z357

HA #	Description	Location	Previously Identified as a Suspect ACM Yes/No	Previously Sampled Yes/No	# of Samples Previously Collected	# of Samples CAPE Collected	ACM Yes/No
01	12" x 12" light brown floor tile and mastic	Throughout 1st floor	Y	Y	1	3	T-N M-N
02	2'x 4' large pegholed ceiling tile	1st & 2nd floor	N	N	0	3	N
03	Built-up roofing material	South side of roof	Y	N	0	3	Y
04	White/gray ceiling plaster	1st floor & 2nd floor above 2' x 4' ceiling tile	Y	Y	1	6	N
05	12" x 12" light green floor tile and (glue) mastic	1st floor, radio vault & offices 2,3,4,5 & 6	Y	Y	1	3	T-Y M-N
06	9" x 9" gray floor tile and mastic	Bottom layer of flooring throughout 1st floor except south end	Y	Y	1	3	T-Y M-Y
07	12" x 12" black border floor tile and mastic	Throughout 1st floor	N	N	0	3	T-N M-N
08	Safe liner	Not present during CAPE's survey	Y	Y	1	0	N
09	<4" aircell pipe insulation	1st & 2nd floor above plaster ceiling & crawlspace	Y	Y	1	0	Y
10	Pipe fittings on <4" fiberglass insulation	1st floor <4" fiberglass insulation	Y	Y	1	2	Y
11	Pipe fittings on HA# 09	Same as HA# 09	N	N	0	3	Y
12	12" x 12" gray floor tile and mastic	1st floor restroom &east end	N	N	0	3	T-N M-N
13	12" x 12" beige floor tile and mastic	1st floor duty room office	N	N	0	3	T-N M-N
14	Black basecove with mastic	1st floor center area	N	N	0	3	N
15	Dark gray basecove with mastic	1st floor officer's office & lounge	N	N	0	3	N
16	Gypsum and joint compound	Throughout	N	N	0	3	N
17	Brown basecove with mastic	Throughout 2nd floor & officer's toilet	N	N	0	3	N
18	Carpet mastic	Throughout	N	N	0	3	N
19	White sink mastic	2nd floor break room	N	N	0	3	Y
20	12" x 12" olive floor tile and mastic	2nd floor break room & restroom	N	N	0	3	T-Y M-N
21	12" x 12" white with tan streaks floor tile and mastic	Restroom & communications	N	N	0	3	T-N M-N
22	12" x 12" dark gray floor tile and mastic	Corridor & lobby	N	N	0	3	N
23	Dark blue basecove with mastic	1st floor north offices	N	N	0	3	N
24	Brown door caulking	Exterior doors	N	N	0	3	N
25	2'x 4' pinhole/fissured ceiling tile	1st floor south end, 2nd floor conference rm.	N	N	0	3	N
26	2' x 4' peghole/fissured ceiling tile	Throughout 1st & 2nd floor	N	N	0	3	N
27	6" brown basecove with mastic	2nd floor, stair #1	N	N	0	3	N
28	12" x 12" tan with brown specks floor tile and mastic	1st floor janitor's closet	N	N	0	3	T-N M-Y

Note: T = Floor Tile, M = Mastic, N = No, Y = Yes

ASBESTOS SAMPLING PLAN AND RESULTS FOR BUILDING Z357 (CONTINUED)

HA #	Description	Location	Previously Identified as a Suspect ACM Yes/No	Previously Sampled Yes/No	# of Samples Previously Collected	# of Samples CAPE Collected	ACM Yes/No
29	12" x 12" blue-gray floor tile and mastic	Corridor & lobby	N	N	0	3	T-N M-N
30	<4" magnesia pipe insulation	1st floor	N	N	0	3	Y
31	12" x 12" brown with orange streaks floor tile and mastic	1st fl, office west of officer's office	N	N	0	3	T-N M-N
32	9" x 9" green floor tile and mastic	South end of commodore office	N	N	0	3	T-Y M-Y
33	6" gray basecove with mastic	2nd floor dispatcher	N	N	0	3	N
34	Roof flashing	South side of roof	N	N	0	3	Y
35	Black mastic on fiberglass Duct insulation	1st floor, north end ducting	N	N	0	3	Y

ASBESTOS SAMPLING PLAN AND RESULTS FOR BUILDING Z2

HA #	Description	Location	Previously Identified as a Suspect ACM Yes/No	Previously Sampled Yes/No	# of Samples Previously Collected	# of Samples CAPE Collected	ACM Yes/No
01	<4" aircell pipe insulation	Bay 1	Y	Y	3	0	Y
02	Pipe fittings on <4" aircell pipe insulation	Bay 1	Y	Y	3	0	Y
03	Pipe fitting on<4" fiberglass pipe insulation	Bay 1	Y	Y	3	0	Y
04	4" Baseboard and Mastic	Main office, Bay 1	Y	Y	3	0	N
05	Plaster wall	Main office, Bay 1 and toilets, Bay 3	Y	Y	3	0	N
06	Gypsum board	Office, Bay 1	Y	Y	3	0	N
07	Joint compound	Office, Bay 1	Y	Y	3	0	N
08	Corrugated transite panels	Bays 2, 3 & 4 on eaves	Y	N	0	3	Y
09	12" x 12" white floor tile & mastic	Offices, Bay 1	Y	N	0	3	T-Y M-Y
10	9" x 9" brown floor tile & mastic	Offices, Bay 1	Y	N	0	3	T-Y M-Y
11	9" x 9" green floor tile and mastic	Offices, Bay 1	Y	N	0	3	T-Y M-N
12	9" x 9" black floor tile & mastic	Offices, Bay 1	Y	N	0	3	T-Y M-Y
13	Black mastic coating on corrugated metal	Exterior siding	N	N	0	3	N
14	Black adhesive on steel pipe	Exterior sprinkler lines	N	N	0	3	N
15	<4" magnesia pipe insulation	Bays 2 & 3	N	N	0	3	Y
16	Gray window putty	Exterior windows	N	N	0	3	Y
17	Paper wrap on >4" fiberglass pipe insulation	Bay 1 and parking area under pier	N	N	0	3	N

Note: T = Floor Tile, M = Mastic, N = No, Y = Yes

APPENDIX B
Lead (and other RCRA Metals) AAS Analysis Results

BUILDING Z86 LEAD AND OTHER RCRA METALS AAS ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 86 01	Conference room, metal electrical panel/beige/green	Arsenic	0.50	N.D.
		Barium	10.0	1,500
		Cadmium	0.50	1.0
		Chromium	5.0	228
		Lead	10.0	1,800
		Mercury	0.50	5.8
		Selenium	1.0	1.7
		Silver	1.0	N.D.
Z 86 02	Men's room corridor, metal door frame/mint green	Arsenic	0.50	3.7
		Barium	10.0	3.82
		Cadmium	0.50	10
		Chromium	5.0	242
		Lead	10.0	2,300
		Mercury	0.50	8.1
		Selenium	1.0	1.8
		Silver	1.0	N.D.
Z 86 03	Classroom wall stripping, concrete block/sea foam green	Arsenic	0.50	N.D.
		Barium	10.0	1,900
		Cadmium	0.50	0.71
		Chromium	5.0	70
		Lead	10.0	1,200
		Mercury	0.50	563
		Selenium	1.0	1.2
		Silver	1.0	N.D.
Z 86 04	Classroom upper wall, concrete block/off-white	Arsenic	0.50	N.D
		Barium	10.0	636
		Cadmium	0.50	2.7
		Chromium	5.0	86
		Lead	10.0	1,120
		Mercury	0.50	47
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 86 05	Office1, plaster wall/light brown	Arsenic	0.50	N.D.
		Barium	10.0	420
		Cadmium	0.50	1.8
		Chromium	5.0	54
		Lead	10.0	1,200
		Mercury	0.50	28
		Selenium	1.0	N.D.
		Silver	1.0	1.5.

BUILDING Z86 LEAD AND OTHER RCRA METALS AAS ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 86 06	Janitor's closet, wood baseboard/light beige	Arsenic	0.50	0.88
		Barium	10.0	166
		Cadmium	0.50	2.5
		Chromium	5.0	14
		Lead	10.0	1,700
		Mercury	0.50	10
		Selenium	1.0	1.3
		Silver	1.0	N.D.
Z 86 07	Men's room, plaster wall/gloss white	Arsenic	0.50	2.9
		Barium	10.0	533
		Cadmium	0.50	12
		Chromium	5.0	137
		Lead	10.0	1,700
		Mercury	0.50	0.93
		Selenium	1.0	1.2
		Silver	1.0	N.D
Z 86 08	Office 8, concrete column/flat white	Arsenic	0.50	9.4
		Barium	10.0	219
		Cadmium	0.50	N.D.
		Chromium	5.0	167
		Lead	10.0	783
		Mercury	0.50	35
		Selenium	1.0	1.9
		Silver	1.0	N.D.
Z 86 09	Test office, brick wall/brown	Arsenic	0.50	3.4
		Barium	10.0	131
		Cadmium	0.50	1.6
		Chromium	5.0	544
		Lead	10.0	199
		Mercury	0.50	42
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 86 10	Waiting room, metal handrail/black	Arsenic	0.50	4.3
		Barium	10.0	421
		Cadmium	0.50	29
		Chromium	5.0	57
		Lead	10.0	15,300
		Mercury	0.50	2.7
		Selenium	1.0	2.4
		Silver	1.0	N.D.

BUILDING Z86 LEAD AND OTHER RCRA METALS AAS ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 86 11	Building exterior, metal rollup door/gray	Arsenic	0.50	5.2
		Barium	10.0	1,600
		Cadmium	0.50	42
		Chromium	5.0	181
		Lead	10.0	37,300
		Mercury	0.50	N.D.
		Selenium	1.0	N.D.
		Silver	1.0	1.9
Z 86 12	Front door foyer, brick wall/dark brown	Arsenic	0.50	2.8
		Barium	10.0	108
		Cadmium	0.50	3.8
		Chromium	5.0	N.D.
		Lead	10.0	764
		Mercury	0.50	0.50
		Selenium	1.0	3.2
		Silver	1.0	N.D.
Z 86 13	Building interior, metal rollup door/white	Arsenic	0.50	N.D.
		Barium	10.0	27,000
		Cadmium	0.50	1.5
		Chromium	5.0	11
		Lead	10.0	436
		Mercury	0.50	2.0
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 86 14	Crawlspace, metal door/gray	Arsenic	0.50	0.90
		Barium	10.0	764
		Cadmium	0.50	31
		Chromium	5.0	3,500
		Lead	10.0	97,000
		Mercury	0.50	2.8
		Selenium	1.0	N.D.
		Silver	1.0	N.D.

BUILDING Z86 RCRA METALS AAS BULK COMPOSITE ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 86 R1	Metal siding & doors/beige, white, gray, black, red & green	Arsenic	0.50	2.1
		Barium	10.0	9,000
		Cadmium	0.50	12.1
		Chromium	5.0	984
		Lead	10.0	29,000
		Mercury	0.50	N.D.
		Selenium	1.0	1.1
		Silver	1.0	N.D.
Z 86 R2	Concrete wall & ceiling/sea foam green, flat white, off-white, brown &dark brown	Arsenic	0.50	1.1
		Barium	10.0	836
		Cadmium	0.50	0.63
		Chromium	5.0	197
		Lead	10.0	1,020
		Mercury	0.50	58
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 86 R3	Plaster wall & ceiling/white, tan & beige	Arsenic	0.50	2.6
		Barium	10.0	238
		Cadmium	0.50	5.8
		Chromium	5.0	177
		Lead	10.0	1,125
		Mercury	0.50	27
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 86 R4	Wood baseboard/light beige & black	Arsenic	0.50	N.D.
		Barium	10.0	246
		Cadmium	0.50	N.D.
		Chromium	5.0	34
		Lead	10.0	1,223
		Mercury	0.50	9.5
		Selenium	1.0	2.2
		Silver	1.0	N.D.

BUILDING Z357 LEAD AND OTHER RCRA METALS AAS ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 35701 L	Building exterior, metal door/frame/brown over white	Arsenic	0.50	N.D.
		Barium	10.0	7,100
		Cadmium	0.50	N.D.
		Chromium	5.0	24
		Lead	10.0	393
		Mercury	0.50	0.53
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 35702 L	Stairwell 1, concrete wall/white over green	Arsenic	0.50	N.D.
		Barium	10.0	6,500
		Cadmium	0.50	N.D.
		Chromium	5.0	26
		Lead	10.0	147
		Mercury	0.50	4.7
		Selenium	1.0	N.D.
		Silver	1.0	N.D
Z 35703 L	Mail room, metal door frame/white over gray	Arsenic	0.50	1.4
		Barium	10.0	859
		Cadmium	0.50	1.4
		Chromium	5.0	245
		Lead	10.0	3,300
		Mercury	0.50	1.7
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 35704 L	Stairwell 1, metal railing/black over green	Arsenic	0.50	3.6
		Barium	10.0	376
		Cadmium	0.50	3.2
		Chromium	5.0	985
		Lead	10.0	9,600
		Mercury	0.50	2.9
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 35705 L	Office 2, gypsum wall/white	Arsenic	0.50	1.7
		Barium	10.0	118
		Cadmium	0.50	N.D.
		Chromium	5.0	13
		Lead	10.0	298
		Mercury	0.50	4.4
		Selenium	1.0	N.D.
		Silver	1.0	N.D.

BUILDING Z357 LEAD AND OTHER RCRA METALS AAS ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 35706 L	Store room, wood door/frame/blue over white	Arsenic	0.50	N.D.
		Barium	10.0	281
		Cadmium	0.50	N.D.
		Chromium	5.0	15
		Lead	10.0	N.D.
		Mercury	0.50	4.0
		Selenium	1.0	1.5
		Silver	1.0	N.D.
Z 35707 L	Commodore's office metal door frame/blue over white over gray over green	Arsenic	0.50	N.D.
		Barium	10.0	245
		Cadmium	0.50	1.3
		Chromium	5.0	17
		Lead	10.0	95
		Mercury	0.50	4.6
		Selenium	1.0	N.D.
		Silver	1.0	N.D
Z 35708 L	N-3 OPS office, concrete wall/cream over white over gray over green	Arsenic	0.50	3.5
		Barium	10.0	1,500
		Cadmium	0.50	N.D.
		Chromium	5.0	147
		Lead	10.0	39
		Mercury	0.50	9.6
		Selenium	1.0	N.D.
		Silver	1.0	N.D.

BUILDING Z357 RCRA METALS AAS BULK COMPOSITE ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z 357-R1	Metal siding & doors/brown, white, gray, black, blue & green	Arsenic	0.50	0.64
		Barium	10.0	831
		Cadmium	0.50	2.9
		Chromium	5.0	347
		Lead	10.0	2,500
		Mercury	0.50	0.84
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z 357-R2	Concrete & block/white, gray & green	Arsenic	0.50	4.9
		Barium	10.0	1,520
		Cadmium	0.50	0.51
		Chromium	5.0	204
		Lead	10.0	587
		Mercury	0.50	6.0
		Selenium	1.0	N.D.
		Silver	1.0	2.2
Z 357-R3	Gypsum walls/white	Arsenic	0.50	1.6
		Barium	10.0	125
		Cadmium	0.50	N.D.
		Chromium	5.0	9.7
		Lead	10.0	82
		Mercury	0.50	6.7
		Selenium	1.0	N.D.
		Silver	1.0	2.0
Z 357-R4	Wood door frames/ blue & white	Arsenic	0.50	N.D.
		Barium	10.0	575
		Cadmium	0.50	N.D.
		Chromium	5.0	28
		Lead	10.0	120
		Mercury	0.50	3.3
		Selenium	1.0	4.5
		Silver	1.0	N.D.

BUILDING Z2 LEAD (AAS) SAMPLE ANALYSIS RESULTS

Sample Number	Sample Description	Detection Limit Mg/kg	Sample Results mg/kg
Z201L	Bay 1- office area & restrooms, plaster walls/tan over green	200.0	10,860
Z202L	Bay 1- office area, plaster walls/rust over tan	200.0	3,300
Z203L	Bay 1- office area, wood doors & frames/white over gray over green	200.0	2,100
Z204L	Bay1- office area, wood doors, baseboards & windows/ brown over gray	200.0	10,825
Z205L	Bay 1- office area, plaster walls/beige over gray	200.0	1,800
Z206L	Building exterior, metal corrugated siding/light yellow	5.0	178
Z207L	Bays 1 & 2 - dividing wall, metal doors & frames/gray	200.0	6,500
Z208L	Bay 1 – floor slab, Concrete/yellow stripes	1,000	93,000
Z209L	Bay 3 – columns, wood/ gray over red	200.0	10,100
Z210L	Bay 2 – transformer room, block/white	5.0	N.D.

BUILDING Z2 RCRA METALS AAS BULK COMPOSITE ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit mg/kg	Sample Results mg/kg, dry wt
Z2-R1	Plaster walls/beige, tan, rust & green	Arsenic	0.50	N.D.
		Barium	10.0	313
		Cadmium	0.50	35
		Chromium	5.0	179
		Lead	10.0	3,900
		Mercury	0.50	N.D.
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z2-R2	Wood doors & frames/white, gray, green & brown	Arsenic	0.50	19
		Barium	10.0	491
		Cadmium	0.50	21
		Chromium	5.0	700
		Lead	10.0	6,300
		Mercury	0.50	7.3
		Selenium	1.0	0.59
		Silver	1.0	N.D.
Z2-R3	Metal siding & doors/yellow & gray	Arsenic	0.50	0.80
		Barium	10.0	351
		Cadmium	0.50	6.1
		Chromium	5.0	5,000
		Lead	10.0	1,300
		Mercury	0.50	8.7
		Selenium	1.0	N.D.
		Silver	1.0	N.D.
Z2-R4	Concrete & block/yellow & white	Arsenic	0.50	2.0
		Barium	10.0	140
		Cadmium	0.50	1.5
		Chromium	5.0	27,000
		Lead	10.0	125,000
		Mercury	0.50	N.D.
		Selenium	1.0	0.54
		Silver	1.0	N.D.

APPENDIX C
Lead (and other RCRA Metals) TCLP Analysis Results

BUILDING Z86, BUILDING Z357 AND BUILDING Z2
LEAD AND OTHER RCRA METALS TCLP ANALYSIS RESULTS

Sample Number	Sample Description	Analyte	Detection Limit Mg/L (ppm)	Hazardous concentration limit mg/L	Sample Results mg/L (ppm)
Z8601T	Concrete, Plaster & Gypsum	Arsenic	0.050	5.0 mg/L	N.D.
		Barium	0.010	100.0 mg/L	0.11
		Cadmium	0.010	5.0 mg/L	N.D.
		Chromium	0.010	1.0 mg/L	0.090
		Lead	0.050	5.0 mg/L	N.D.
		Mercury	0.0010	0.002 mg/L	N.D.
		Selenium	0.050	1.0 mg/L	N.D.
		Silver	0.010	5.0 mg/L	N.D.
Z35701T	Concrete, Plaster & Gypsum	Arsenic	0.050	5.0 mg/L	N.D.
		Barium	0.010	100.0 mg/L	0.090
		Cadmium	0.010	5.0 mg/L	N.D.
		Chromium	0.010	1.0 mg/L	0.030
		Lead	0.050	5.0 mg/L	N.D.
		Mercury	0.0010	0.002 mg/L	N.D.
		Selenium	0.050	1.0 mg/L	N.D.
		Silver	0.010	5.0 mg/L	N.D.
Z201T	Concrete & Asphalt Slab	Arsenic	0.050	5.0 mg/L	N.D.
		Barium	0.010	100.0 mg/L	0.18
		Cadmium	0.010	5.0 mg/L	N.D.
		Chromium	0.010	1.0 mg/L	0.76
		Lead	0.050	5.0 mg/L	N.D.
		Mercury	0.0010	0.002 mg/L	N.D.
		Selenium	0.050	1.0 mg/L	N.D.
		Silver	0.010	5.0 mg/L	N.D.
Z202T	Metal, Wood & Plaster	Arsenic	0.050	5.0 mg/L	N.D.
		Barium	0.010	100.0 mg/L	0.12
		Cadmium	0.010	5.0 mg/L	N.D.
		Chromium	0.010	1.0 mg/L	0.31
		Lead	0.050	5.0 mg/L	0.11
		Mercury	0.0010	0.002 mg/L	N.D.
		Selenium	0.050	1.0 mg/L	N.D.
		Silver	0.010	5.0 mg/L	N.D.

APPENDIX D
Bulk Sample Location Drawings

APPENDIX E
PLM Bulk Sample Analysis Reports

APPENDIX F
TEM Bulk Sampling Plan and Results

APPENDIX F

TEM BULK SAMPLING PLAN AND RESULTS

FOR FLOORING SAMPLES IN WHICH NO ASBESTOS WAS DETECTED BY PLM

	Bldg. #	HA #	Description	TEM Results
1.	Z86	06	Tan with brown specks 12” x 12” Floor Tile	ND
2.	Z86	07	Off-white with green streaks 12” x 12” Floor Tile	ND
3.	Z357	01	Light Brown 12” x 12” Floor Tile	trace
4.	Z357	07	Black 12” x 12” Floor Tile	ND
5.	Z357	12	Gray 12” x 12” Floor Tile	ND
6.	Z357	13	Beige 12” x 12” Floor Tile	trace
7.	Z357	21	White with tan streaks 12” x 12” Floor Tile	ND
8.	Z357	22	Dark Gray 12” x 12” Floor Tile	ND
9.	Z357	28	Tan with brown specks 12” x 12” Floor Tile	ND
10.	Z357	29	Bluish-gray 12” x 12” Floor Tile	ND
11.	Z357	31	Brown with orange streaks 12” x 12” Floor Tile	ND

Notes: ND = Not Detected

APPENDIX G
AAS Sample Analysis Reports

APPENDIX H
TCLP Sample Analysis Reports

SECTION 13282

REMOVAL AND DISPOSAL OF PAINTED BUILDING SURFACES CONTAINING LEAD
06/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead Exposure in Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
29 CFR 1926.103	Respiratory Protection
40 CFR 260	Resource Conservation and Control Act (RCRA): Hazardous Waste Management Systems: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standard for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions

40 CFR 745	Toxic Substance Control Act (TSCA) Title IV: Lead; Requirements for Lead-Based Paint Activities
49 CFR 172	Hazardous Materials, Tables, and Hazardous Materials Communications Regulations
49 CFR 178	Shipping Container Specification

UNDERWRITERS LABORATORIES INC. (UL)

UL 586	(1990; R1995) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 1.5 to 1.8 meters above the floor).

1.2.3 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. An industrial hygienist certified by the American Board of Industrial Hygiene or a safety professional certified by the Board of Certified Safety Professionals is the best choice. The CP shall be trained as a lead risk assessor in accordance with 40 CFR 745.

1.2.4 Contaminated Room

Room for removal of contaminated personal protective equipment (PPE).

1.2.5 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.6 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

1.2.7 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.2.8 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

1.2.9 Lead Control Area

A temporary area or structure or containment, sometimes equipped with HEPA filtered local exhaust, that prevents the spread of lead dust or debris. Usually critical barriers and physical boundaries are employed to isolate the lead control area and to prevent migration of lead contamination and unauthorized entry of personnel.

1.2.10 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.11 Paint Containing Lead (PCL)

Any painted material which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a valid detection method.

1.2.12 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 150 to 225 mm and centered at the nose or mouth of an employee.

1.2.13 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

1.2.14 RCRA Metals Containing Paint

Protective or decorative coating which contains a cadium, lead, mercury, selenium or silver.

1.2.15 DESCRIPTION OF WORK

Remove painted building material containing lead and the other RCRA metals as indicated on the drawings.

1.3 SUBMITTALS

Submit the following in accordance with Section entitled "Submittal Procedures."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Vacuum filters G

b. Respirators G

1.3.2 SD-06, Instructions

a. Chemicals and equipment G

b. Material safety data sheets for all chemicals G

1.3.3 SD-08, Statements

a. Qualifications of CP G

b. Testing laboratory qualifications G

c. Third party consultant qualifications G

d. Material Containing Lead Removal Plan including CP approval (signature, date, and certification number) G

e. Rental equipment notification G

f. Respiratory protection program G

g. Hazard communication program G

h. EPA approved hazardous waste treatment or disposal facility for lead disposal G

i. Hazardous waste management plan G

j. Assessment data report G

1.3.3.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained in accordance with federal, State, and local laws.

1.3.3.2 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory participating in the EPA National Lead Laboratory Accreditation Program (NLLAP) by being accredited by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis.

1.3.3.3 Material Containing Lead Removal Plan (MCLRP)

Submit a detailed job-specific plan of the work procedures to be used in the removal of MCL. The plan shall include a sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air and baseline lead dust concentrations are not reached or exceeded outside of the lead control area. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan.

1.3.3.4 Third Party Consultant Qualifications

Submit the name, address and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.3.4 SD-12, Field Test Reports

a. Sampling results G

b. Assessment Data Report G

1.3.4.1 Occupational and Environmental Sampling Results

Submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

a. The sampling results shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead.

b. Submit worker exposure data conducted during the task based trigger operations of 29 CFR 1926.62.

c. The initial monitoring shall determine the requirements for further monitoring and the need to fully implement the control and protective requirements including the compliance program (MCLRP) per 29 CFR 1926.62.

1.3.4.2 Occupational and Environmental Assessment Data Report

The MCL removal work does not require full implementation of the requirements of 29 CFR 1926.62. Based on the experience of the Contractor and the use of a specific process or method for performing the work, the Contractor shall provide historic data (previous 12 months) to demonstrate that airborne exposures are controlled below the action level. Such methods or controls shall be fully presented in the MCLRP. In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation in an Assessment Data Report.

Submit occupational and environmental assessment report to the Contracting Officer prior to start of work, signed by the testing laboratory employee performing the analysis, and the CP.

a. Submit a report that supports the determination regarding the reduction of the need to fully implement the requirements of 29 CFR 1926.62 and supporting the MCLRP. The exposure assessment shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data conducted during the task based trigger operations of 29 CFR 1926.62 with a complete process description in supporting a negative assessment.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the compliance program (MCLRP) per 29 CFR 1926.62.

1.3.5 SD-13, Certificates

a. Vacuum filters G

1.3.6 SD-18, Records

a. Completed and signed hazardous waste manifest from treatment or disposal facility G

b. Certification of medical examinations G

c. Employee training certification G

1.4 QUALITY ASSURANCE

1.4.1 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103.

1.4.1.1 Medical Records

Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.4.1.2 Medical Surveillance

Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62.

1.4.2 Competent Person (CP) Responsibilities

a. Certify training as meeting all federal, State, and local requirements.

b. Review and approve Material Containing Lead Removal Plan (MCLRP) for conformance to the applicable referenced standards.

c. Continuously inspect MCL removal work for conformance with the approved plan.

d. Perform air and non-clearance type wipe sampling.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Control work to prevent hazardous exposure to human beings and to the environment at all times.

g. Certify the conditions of the work as called for elsewhere in this specification.

1.4.3 Training

Each employee shall be trained in performing lead removal work, MCL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and 40 CFR 745 as lead workers.

1.4.3.1 Training Certification

Submit a certificate for each employee, signed and dated by the TSCA certified training provider, stating that the employee has received the required lead training.

1.4.4 Respiratory Protection Program

a. Furnish each employee required to wear a respirator with a respirator fit test at the time of initial fitting and at least every six months thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.4.5 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.4.6 Hazardous Waste Management

The Hazardous Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of hazardous wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of USEPA State hazardous waste permits and USEPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.

h. Unit cost for hazardous waste disposal according to this plan.

1.4.7 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

1.4.8 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Hazardous Waste Management Plan and the Material Containing Lead Removal Plan, including work procedures and precautions for the removal plan.

1.5 EQUIPMENT

1.5.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.5.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.5.3 Rental Equipment Notification

If rental equipment is to be used during MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.5.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.5.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. Respiratory protection for the Contracting Officer will be provided by the Government.

PART 2 PRODUCTS

2.1 CHEMICALS

Submit applicable Material Safety Data Sheets for all chemicals used in lead removal work. Use the least toxic product approved by the Contracting Officer.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Notification

Notify the Contracting Officer 20 days prior to the start of any lead work.

3.1.2 Boundary Requirements

3.1.2.1 Physical Boundary

Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

3.1.2.2 Warning Signs

Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.3 Furnishings

The Government will remove furniture and equipment from the building before lead hazard abatement work begins.

3.1.4 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.5 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.6 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.

c. Vent local exhaust outside the building.

d. Use locally exhausted, power actuated tools or manual hand tools.

3.1.7 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 WORK PROCEDURES

Perform lead work in accordance with approved MCLRP. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when lead hazard abatement is performed in accordance with 29 CFR 1926.62 and 40 CFR 745, and as specified herein. Dispose of all MCL and associated waste in compliance with federal, State, and local requirements.

3.2.1 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn in the control area:

a. Vacuum themselves off.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.

d. Change to clean clothes prior to leaving the clean clothes storage area.

3.2.2 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and non-clearance wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the MCL removal work to ensure that the requirements of the contract have been satisfied during the entire MCL operation.

b. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken. Notify the Contracting Officer immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.

3.2.2.1 Air Sampling During Material Containing Lead Removal Work

Conduct area air sampling at least daily in areas immediately adjacent to the lead control area on each shift in which lead hazard abatement operations are performed. Sufficient area monitoring shall be conducted to ensure unprotected personnel outside of the control area are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after approval is given by the CP and the Contracting Officer. For outdoor operations, at least one sample on each work shift shall be taken on the downwind side of the lead control area at a site selected by the CP and approved in advance by the Contracting Officer.

3.2.3 Material Containing Lead Removal

Manual or power sanding or grinding of MCL is not permitted.

Select MCL removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this MCL removal process in the MCLRP.

3.2.3.1 Material Containing Lead - Indoor Removal

Perform mechanical removal in the lead control areas using powered locally exhausted tools. Collect residue and debris for disposal in accordance with federal, State, and local requirements.

3.2.3.2 Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the MCLRP. The worksite preparation (barriers or containments) shall be job dependent and presented in the MCLRP.

3.2.3.3 Sampling After MCL Removal

After the visual inspection collect air samples inside the work area.

3.2.4 Cleanup and Disposal

3.2.4.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the MCLRP. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before clearance testing.

3.2.4.2 Clearance Certification

The CP shall certify in writing that the final air samples collected inside and outside the lead control area are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

3.2.4.3 Testing of Material Containing Lead Residue

Test MCL residue in accordance with 40 CFR 261 for hazardous waste.

3.2.4.4 Disposal

a. All material, whether hazardous or non-hazardous shall be disposed in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA metals) will dictate disposal requirements. Contractor shall base bid price on the hazardous waste disposal of paint chips and HEPA vacuum debris as RCRA metals containing waste. All other materials should be tested by TCLP and the Contractor shall base bid price on non-hazardous disposal.

b. Contractor is responsible for segregation of waste. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing which may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261. Dispose of lead-contaminated waste material at an EPA approved hazardous waste treatment, storage, or disposal facility off Government property.

c. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 208 liter drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

d. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.2.5 Disposal Documentation

Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and State or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.

3.2.6 Payment for Hazardous Waste

Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Government.

-- End of Section --

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SECTION 13286

HANDLING OF LIGHTING BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communication, Emergency Response Information, and Training Requirements.
49 CFR 178	Shipping Container Specification

1.2 REQUIREMENTS

Removal and disposal of PCB containing lighting ballasts and associated mercury-containing lamps. Contractor may encounter leaking PCB ballasts.

1.3 DEFINITIONS

1.3.1 Certified Industrial Hygienist (CIH)

A industrial hygienist hired by the contractor shall be certified by the American Board of Industrial Hygiene.

1.3.2 Leak

Leak or leaking means any instance in which a PCB article, PCB container, or PCB equipment has any PCBs on any portion of its external surface.

1.3.3 Mercury-Containing Lamps

As used in this specifications shall mean all fluorescent and high-intensity discharge (HID) lamps scheduled for demolition and/or removal as indicated in the Contract documents.

1.3.4 Polychlorinated Biphenyls (PCBs)

PCBs as used in this specification shall mean the same as PCBs, PCB containing lighting ballast, and PCB container, as defined in 40 CFR 761, Section 3, Definitions.

1.3.5 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

Perform PCB related work in accordance with 40 CFR 761. Perform mercury-containing lamp storage and transport work in accordance with 40 CFR 262 and 40 CFR 263.

1.4.2 Training

Certified industrial hygienist (CIH) shall instruct and certify the training of all persons involved in the removal of PCB containing lighting ballasts and mercury-containing lamps. The CIH shall review and approve the PCB and Mercury-Containing Lamp Removal Work Plan. The CIH shall also be responsible for instruction of employees on the dangers of PCB and mercury exposure, decontamination, and applicable OSHA and EPA regulations.

1.4.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site 29 CFR 1910.1000, 40 CFR 761, 40 CFR 262, 40 CFR 263, and removal work plan, and disposal plan for PCBs and associated mercury-containing lamps.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.5.1 SD-08, Statements

a. Qualifications of CIH G

b. Training Certification G

c. PCB and Mercury-Containing Lamp Removal Work Plan G

d. PCB and Mercury-Containing Lamp Disposal Plan G

1.5.1.1 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit training certification that the Industrial Hygienist is certified, including certification number and date of certification or re certification.

1.5.1.2 PCB and Mercury-Containing Lamp Removal Work Plan

Submit a job-specific plan within 15 calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of PCB-containing lighting ballasts and associated mercury-containing lamps. Include in the plan: Requirements for U.C. Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by the Certified Industrial Hygienist. Obtain approval of the plan by the Contracting Officer prior to the start of PCB and/or lamp removal work.

1.5.1.3 PCB and Mercury-Containing Lamp Disposal Plan

Submit a PCB Disposal Plan with 45 calendar days after award of contract. The PCB and Mercury-Containing Lamp Disposal Plan shall comply with applicable requirements of federal, state, and local PCB and RCRA waste regulations and address:

a. Estimated quantities of wastes to be generated, disposed of, and recycled.

b. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location. Furnish two copies of EPA and state PCB and mercury-containing lamp waste permit applications and EPA identification numbers.

c. Names and qualifications (experience and training) of personnel who will be working on-site with PCB and mercury-containing lamp wastes.

d. Spill prevention, containment, and cleanup contingency measures to be implemented.

e. Work plan and schedule for PCB and mercury-containing lamp waste containment, removal, disposal, and or recycling. Wastes shall be cleaned up and containerize daily.

1.5.2 SD-18, Records

a. Transporter certification of notification to EPA of their PCB waste activities and EPA ID numbers G

b. Certification of Decontamination G

c. Certificate of Disposal and/or Recycling. Submit to the Government before application for payment within 30 days of the date that the disposal of the PCB and mercury-containing lamp waste identified on the manifest was completed. G

1.6 ENVIRONMENTAL REQUIREMENTS

Use special clothing:

a. Disposable gloves (polyethylene)

b. Eye protection

c. PPE as required by CIH

1.7 SCHEDULING

Notify the Contracting Officer 20 days prior to the start of PCB and mercury-containing lamp removal work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the removal of PCB containing lighting ballasts, associated mercury-containing fluorescent lamps, and high intensity discharge (HID) lamps in accordance with local, state, or federal regulations. PCBs shall not be exposed to open flames or other high temperature sources since toxic decomposition by-products may be produced. By the same reasoning, fluorescent lamps and HID lamps shall not be broken since the release of mercury into the environment may occur.

3.1.1 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761 and the applicable requirements of this section, including but not limited to:

a. Obtaining suitable PCB and mercury-containing lamp storage sites.

b. Notifying Contracting Officer prior to commencing the operation.

c. Reporting leaks and spills to the Contracting Officer.

d. Cleaning up spills.

e. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the Contracting Officer.

f. Maintaining inspection, inventory and spill records.

3.2 PCB SPILL CLEANUP REQUIREMENTS

3.2.1 PCB Spills

Immediately report to the Contracting Officer any PCB spills on the ground or in the water. PCB spills in drip pans, or PCB leaks.

3.2.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

3.2.3 PCB Spill Cleanup

40 CFR 761, subpart G. Initiate cleanup of spills as soon as possible, but no later than 24 hours of its discovery. Mop up the liquid with rags or other conventional absorbent. The spent absorbent shall be properly contained and disposed of as solid PCB waste.

3.2.4 Records and Certification

Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125, Requirements for PCB Spill Cleanup. Provide certification of decontamination.

3.3 REMOVAL

3.3.1 Ballasts

As ballasts are removed from the lighting fixture, inspect label on ballast. Ballasts labeled "No PCBs" shall be segregated from the waste and disposed of as normal demolition debris. Ballasts without the "No PCBs" label shall be assumed to contain PCBs and containerized.

3.3.2 Lighting Lamps

Remove lighting tubes/lamps from the lighting fixture and carefully place (unbroken) into appropriate containers (original transport boxes or equivalent).

3.4 STORAGE FOR DISPOSAL

3.4.1 Storage Containers for PCBs

49 CFR 178. Store PCB in DOT Specification 5, 5B, or 17C containers with removable heads.

3.4.2 Storage Containers for lamps

Store lamps in appropriate transport containers. The boxes shall be store and labeled for transport in accordance with 40 CFR 262 and 40 CFR 263.

3.4.3 Labeling of Waste Containers

Label with the following:

a. Date the item was placed in storage and the name of the cognizant activity/building.

b. PCB Caution Label, conforming to paragraph entitled "PCB Caution Label." 40 CFR 761, Subpart C. Affix labels to PCB waste containers.

c. Label mercury-containing lamp waste in accordance with 49 CFR 172. Affix labels to all lighting waste containers.

3.5 DISPOSAL

Dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

3.5.1 Identification Number

Comply with disposal requirements and procedures outlined in 40 CFR 761 and 40 CFR 263. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Uniform Hazardous Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work.

3.5.2 Transporter Certification

Comply with disposal requirements and procedures outlined in 40 CFR 761 and 40 CFR 263. Before transporting the PCB and lamp waste, sign and date the manifest acknowledging acceptance of the PCB and mercury-containing waste from the Government. Return a signed copy to the Government before leaving the job site. Ensure that the manifest accompanies the PCB and lamp waste at all times. Submit transporter certification of notification to EPA of their PCB and lamp waste activities (EPA Form 7710-53).

3.5.2.1 Certificate of Disposal and/or Recycling

40 CFR 761. Certificate for the PCBs and PCB items, and lamps disposed shall include:

a. The identity of the disposal and/or recycling facility, by name, address, and EPA identification number.

b. The identity of the PCB and lamp waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.

c. A statement certifying the fact of disposal and or recycling of the identified PCB and/or lamp waste, including the date(s) of disposal, and identifying the disposal process used.

d. A certification as defined in 40 CFR 761, Section 3.

-- End of Section --

SECTION 13851

EXTERIOR FIRE ALARM SYSTEM, CLOSED CIRCUIT TELEGRAPHIC TYPE
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1998) Approval Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code
NFPA 72	(1996) National Fire Alarm Code
NFPA 1221	(1996) Installation, Maintenance, and Use of Public Fire Service Communications Systems

UNDERWRITERS LABORATORIES INC. (UL)

UL FPED	(1998) Fire Protection Equipment Directory
UL 38	(1994; R 1994, Bul. 1995) Manually Actuated Signaling Boxes For Use with Fire-Protective Signaling Systems
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" 16303, "Underground and Underpier Electrical Work "; apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Installer

The installer of the exterior fire alarm system; either the Contractor or subcontractor proposed by the Contractor to perform the work and with whom the Contractor has a firm contractual agreement.

1.4 SYSTEM DESCRIPTION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 72and NFPA 1221, except as modified herein. Except as modified herein, the exterior fire alarm reporting system shall comply with NFPA 72

Style B for initiating circuits, Style 2 for signaling circuit andNFPA 1221 for a Type B system. Design the system to operate on direct current supplied from a rectifier and storage batteries. The exterior fire alarm reporting shall include the following features:

a. A complete, electrically supervised, normally-closed series, coded, positive noninterfering type of circuit.

b. Succession features, whereby alarms from coded boxes are transmitted over box circuits to fire alarm headquarters.

(1) Alarms that are manually retransmitted to each branch fire station and to recording and sounding devices in the system.

(2) Regardless of location, the first coded box operated shall transmit four complete rounds of code without interference from any other box.

(3) Other coded boxes that may have been operated during this period and that shall then transmit one at a time as the circuit becomes available until all boxes in an alarm condition have completed four rounds of code.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures." The fire protection engineer, Atlantic Division, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval.

1.5.1 SD-02 Manufacturer's Catalog Data

a. Testing instruments G

b. Fire alarm boxes G

c. Pedestal G

d. Wires and cables G

1.5.2 SD-04 Drawings

a. Exterior fire alarm reporting G

Submit detail plan showing the location of fire alarm equipment and devices with complete point to point wiring diagrams. Wiring diagrams shall show points of connection and terminals to be used, and interior wiring diagrams of each component. Clearly and completely indicate the function of the control panel and devices connected thereto. Drawings should be 1189 by 841 mm .

1.5.3 SD-08 Statements

a. Parts reliability G

b. Installer qualifications G

c. Test procedures G

d. Installation certificate G

e. Installation personnel G

f. Current UL listings or FM approvals G

1.5.3.1 Parts Reliability

Certify that materials and equipment furnished are identical to items that have been in satisfactory use for at least two years prior to bid opening.

1.5.3.2 Installer Qualifications

Prior to installation, submit evidence including system type and design showing that the installer has successfully installed at least two exterior fire reporting alarm systems of the same type. Include the names and locations of the installations and written certification from the users that the systems have performed satisfactorily for a period of not less than 18 months.

1.5.3.3 Test Procedures

Submit detailed test procedures for the fire alarm system 30calendar days prior to performing system tests.

1.5.3.4 Installation Certificate

Upon completion of construction, submit an installation certificate issued by a service company listed in UL FPED, under "Protection Signaling Services - Local, Auxiliary, Remote Station Proprietary."

1.5.3.5 Installation Personnel

Submit names of personnel who will supervise installation and testing of the system, and who will furnish instruction to Government personnel, along with the manufacturer's certification of the qualifications of the named individuals.

1.5.3.6 UL Listings/FM Approvals

Submit copies of current UL listings or FM approvals for the system in configurations offered, with copies of the actual UL or FM test results.

1.5.4 SD-12 Field Test Reports

a. Ground resistance tests G

b. Dielectric strength and insulation resistance tests G

c. Box and transmitter tests G

d. Final performance and acceptance tests G

After successful completion of the final acceptance tests, submit test results in booklet form showing field tests performed were in compliance with the specified performance criteria. In each test report, indicate the final position of controls.

1.5.5 SD-18 Records

a. Record wiring diagrams G

1.5.5.1 Record Wiring Diagrams

Submit diagrams prior to final testing of the system.

1.5.6 SD-19 Operation and Maintenance Manuals

a. Fire alarm boxes, Data Package 5 G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

1.6.1.1 Installer

The installer shall have successfully completed installations of at least two exterior fire alarm systems conforming to the requirements of the NFPA and of the same type and design specified herein. Ensure the installer is UL certified for the installation and testing of Fire Alarm Systems. Provide proof of this listing. A list of installer's personnel shall be provided as part of the submittal package referred in subparagraph entitled "SD-08, Statements."

1.6.1.2 Fire Alarm System Technician or Engineer

Make installation, adjustments, and tests under the supervision of a technician or engineer retained by the Contractor who is qualified with at least 2 years' experience in the installation and operation of exterior fire alarm systems of the type specified.

a. Qualification of technician:

Installation drawings, shop drawings and as-built drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of works specified herein, and is certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in fire alarm system program. Contractor shall submit data showing the names and certification of the technician at or prior to submittal of drawings.

1.6.2 Modification of References

In the NFPA publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Engineering Field Division Fire Protection Engineer.

1.6.3 Regulatory Requirements

Materials and equipment for fire alarm service shall be listed by UL FPED or approved by FM P7825. Provide current materials and equipment of one manufacturer regularly engaged in production of such equipment, and provide items that have performed satisfactorily for at least 2 years prior to bid opening.

1.7 DELIVERY, STORAGE AND HANDLING

Store and protect equipment from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

1.8 EXISTING CONDITIONS

Existing system was manufactured by Gamewell, and new equipment shall be compatible with and not reduce existing system operations and reliability.

1.9 MAINTENANCE

1.9.1 Special Tools

Furnish a suitable testing instruments, metal tool box and special tools required for the maintenance of the equipment to the Contracting Officer.

1.9.2 Spare Parts

a. Five spare lamps of each type;

b. Two fire alarm box mechanisms;

PART 2 PRODUCTS

2.1 STANDARD FIRE ALARM BOXES

Connect manual stations into alarm initiating circuit. Provide coded, positive, noninterfering type with succession features. Provide boxes capable of transmitting through ground in the event of a single open in the circuit. Provide pre-wound, open-door-pull-lever type boxes that conform to applicable requirements of UL 38. The house mechanism shall be in a weatherproof cottage-shell type of housing with metallic bronze or nickel-alloy or rigid plastic code number plate mounted on the exterior face of the cottage shell. Stations requiring breaking of glass or plastic panels for operation are not acceptable; however, stations employing glass rods are acceptable. Gravity or mercury switches are not acceptable. Finish the housing in gloss red enamel with a reflective, highly visible label imprinted with the word "FIRE" in minimum 50 mm block characters on both sides of the box. Code wheel shall be metallic and code shall be as developed by the coding plan for the code wheel location. Operation of the actuating pull lever shall cause the box to transmit 4 complete round groups of code to all gongs, recorders, and other devices on the circuit to which the pull lever is connected. Driving springs shall have the capability to transmit not less than 8 complete 4-round groups of code before being rewound. Design boxes for operation on 100 milliamperes dc, but with capability of full operation at 70 milliamperes and up to 120 milliamperes. Box mechanism shall be capable of transmitting signals at varying rates of speed ranging from electrical impulses at 3 1/4 second intervals to 1/4 second intervals and shall be field adjustable to any speed within this range. Equip each box with manual signaling key, silent test device, and box shunt device.

2.1.1 Master Fire Alarm Boxes

Provide type identical to standard boxes except that, in addition, equip each master box with a shunt type auxiliary tripping coil for connection to building protective or alarm system devices. Provide a shunt trip master box within the communications room and connect manual auxiliary boxes located throughout the pier. Provide Gamewell Vitaguard stations or approved equal.

2.1.2 Fire Alarm Box Mounting

Provide mounting and marker lamps as indicated on the electrical sheets. Pedestal shall include box mounting assembly, terminal strip, and terminal strip access door.

2.1.3 Fire Alarm Box Grounding

Provide connection from the grounding terminal connection of the box to either a driven ground rod or a buried, metallic water pipe. Resistance to ground shall not exceed 5 ohms. Do not consider the grounded neutral connection of a three-phase or single-phase power supply as an adequate ground for the fire alarm box ground.

2.2 WIRING

Provide color coded wires and cables.

2.2.1 Cables for Fire Alarm Service

2.2.1.1 Underground Cables

Cables provided in duct-and-manhole systems shall be in accordance with Sections and 16303, "Underground and Underpier Electrical Work." Concrete work for underground distribution system and appurtenances shall be in accordance with Sections 03300, "Cast-In-Place Concrete"16303, "Underground and Underpier Electrical Work". Power wiring shall be copper Type USE conductors not less than No. 12 AWG in size conforming to NFPA 70. Exterior fire alarm reporting system cable shall consist of individually insulated conductors and double polyethylene outer jacket not less than No. 8 AWG in size. Wires and cables shall be one piece without splices between connections except where the distance exceeds the lengths in which cable is manufactured. Make splices only in manholes, handholes, or other protected and accessible space.

2.2.1.2 Identification Slabs (Markers)

Provide markers in accordance with Sections 16303, "Underground and Underpier Electrical Work," and provide at each change of direction of cable, over the ends of ducts or conduits that are provided under paved areas and roadways, and over each splice.

2.2.2 Wire Markers

Provide markers at both ends of each wire connected to the control board. Provide taped-band type markers, of permanent material, permanently stamped with the proper identification. The taped band shall be white and the markings black in color so that the identification can be easily read. Attach the markers to the wires in a manner that will not permit accidental detachment.

2.3 CONDUIT

Provide conduit type as indicated per Sections 16403, "Electrical Distribution System."

2.4 GROUND RODS

Rods shall be the sectional type, copper-encased steel, with a minimum diameter of 19 mm and a minimum length of 3045 mm. The rods shall have a hard, clean, smooth, continuous copper surface, and the proportion of copper shall be uniform throughout the length of the rod. Copper shall have a minimum wall thickness of 0.33 mm at any point on the rod. Rods shall comply with the UL 467 requirements.

2.5 KEYS AND LOCKS

Key locks alike. Furnish tags with stamped identification number for keys and locks.

2.6 NAMEPLATES

Securely attach to each major component of equipment a noncorrosive and nonheat sensitive plate indicating the manufacturer's name, address, type or style, voltage and current and current rating, and catalog number.

2.7 PAINTING

Factory paint switch boxes, fire alarm boxes and transmitters with a priming coat and not less than two coats of a hard, durable weatherproof enamel. The finish color shall be redgloss. Treat and paint control boards in accordance with the manufacturer's standard practice. Steel pedestals and other exterior work shall have a suitable priming coat and not less than two coats of approved enamel with finish color as selected by the Contracting Officer. Repaint painted surfaces damaged during installation of the exterior fire alarm reporting and receiving system with color to match existing paint.

PART 3 EXECUTION

3.1 INSTALLATION

Install the exterior fire alarm reporting and receiving system in accordance with NFPA requirements, the manufacturer's diagrams and recommendations, and this section.

3.2 VERIFICATION OF CONDITIONS

Become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of discrepancies before performing the work.

3.3 WIRING

Wiring shall be in PVC conduit. Identify circuit conductors within each enclosure where a tap, splice, or termination is made. Attach markers in a manner that will not permit accidental detachment. Identify control circuit terminations. Unless otherwise indicated, wiring and conduit will be new. Do not run fire alarm circuits in the same conduit with non-fire alarm circuits. Do not run ac circuits in the same conduit with dc circuits.

3.4 GROUNDING

Ground equipment in accordance with NFPA 70. Measure the resistance of each connection to ground. Ground resistance shall not exceed 5 ohms.

3.5 CABLE SPLICES

Make splices only where the distance between connections exceeds the length in which the cable is manufactured. Splices shall conform to Section 16303, "Underground and Underpier Electrical Work," and the cable manufacturer's recommendations.

3.6 SPECIAL CONNECTIONS

3.6.1 Branch or "Y" Connections for Cables

Make these connections only aboveground at fire alarm stations, on structures, or in manholes and handholes as approved. Provide cable terminations in fire alarm station enclosures or in boxes or cabinets equipped with telephone-type terminal boards. Provide weatherproof enclosures in exterior or wet locations and watertight in manholes and handholes.

3.6.2 Welded and Brazed Connections

Welding or brazing process shall not weaken the parts joined and shall join strands. Provide welding process so that the completed joint or connection will be one homogeneous mass equal to or larger in size than the cables and wires joined. An exothermic type welding method may be used, employing a measured heat supply and molds designed for the conductors joined. Perform brazing process with operators experienced in work of a similar character and in a manner that will not damage the parts joined. Approved splice cap swaged spike terminations, insulation wrapped and epoxy potted, may be substituted for welded and brazed connections.

3.7 CORROSION AND FUNGUS PREVENTION

Protect metallic materials against corrosion. Coat outdoor equipment with a rust inhibiting treatment and standard finish by the manufacturer. Do not use aluminum in contact with the earth. Protect dissimilar metals with approved fittings and treatment. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a single layer of a pressure sensitive plastic tape, half-lapped. Protect components against corrosion and fungus. Coat printed circuit board with epoxy.

3.8 FIELD QUALITY CONTROL

3.8.1 Tests During Installation

Conduct the following tests during installation of wiring and system components. Correct deficiencies prior to formal functional and operational tests of the system. Tests shall include meggering system conductors to determine that system is free from grounded or open circuits. Complete the megger test prior to installation of fire alarm equipment.

3.8.1.1 Ground Resistance Tests

Resistance of each connection to ground shall be measured and not exceed 5 ohms.

3.8.1.2 Dielectric Strength and Insulation Resistance Tests

Test dielectric strength and insulation resistance of the system interconnecting wiring by means of an instrument capable of generating 500 V dc and equipped to indicate leakage current in terms of resistance. Provide test instrument capable of indicating 1000 megohms. For the purpose of this test, connect the instrument between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open-circuited and series-connected devices in place. The system shall withstand the test without breakdown and indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than one minute with a dc potential of not less than 100 volts nor more than 550 V dc.

3.8.1.3 Box and Transmitter Tests

Prior to commencement of tests, prepare sketches on letter-size sheets indicating electrical sequence from the control panel of manual boxes and transmitters. Test each box on each box circuit as follows: Electrically operate the farthest box from the fire station first. Examine the printout to determine if the code contacts cause a uniform signal to be transmitted through each of the four rounds. This test will provide a check on the box operation and code contacts. Test the succeeding boxes or transmitters successively until each box in the box circuit has been tested as specified. Test each box circuit separately to determine that, should two or more devices be operated at or near the same time, the device first securing the line shall continue to transmit its code without interference from other devices, and that the remaining actuated devices shall similarly and subsequently transmit their codes without interference as the line becomes available.

3.8.2 Final Performance and Acceptance Tests

After the system has been in service for at least 30 calendar days, notify the Contracting Officer in writing that the system is ready for final acceptance tests. Provide notification at least 15 calendar days prior to the date of the final acceptance test. Submit with this notification a certificate from a service company listed in the UL FPED, under "Protective Signaling - Local, Auxiliary-Remote Station and Proprietary," which includes tests specified in paragraphs entitled "Ground Resistance," "Dielectric Strength and Insulation Resistance," "Box and Transmitter Test." Consider the system ready for testing after necessary preliminary tests have been made and deficiencies have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Engineering Field Division Fire Protection Engineer.

3.8.2.1 Acceptance Testing

Furnish proposed test procedures for approval at least 60 calendar days prior to commencement of acceptance testing. Perform the tests in the presence of the Engineering Field Division Fire Protection Engineer or authorized representative under the supervision of the fire alarm reporting system manufacturer's qualified representative. Furnish instruments, labor, and materials required for the tests. Arrange for the technician who supervised the installation to conduct the tests. Correct deficiencies found and retest the system. Repeat tests specified in paragraph entitled "Tests During Installation" as directed by the Engineering Field Division

Fire Protection Engineer during final acceptance tests.

3.8.3 Additional Tests

When deficiencies, defects, or malfunctions develop during the tests required, suspend further testing of the system until proper adjustments, corrections, or revisions have been made to ensure proper performance of the system. If these revisions require more than a nominal delay, notify the Contracting Officer when the additional work has been completed to arrange a new inspection and test of the exterior fire alarm reporting and receiving system. Repeat tests required prior to final acceptance, unless directed otherwise.

3.8.4 Manufacturer's Field Service

3.8.4.1 Manufacturer's Representative

Furnish the services of a qualified representative or technician of the system manufacturer, experienced in the installation and operation of the type of system being provided to supervise testing, including final testing, and adjustment of the system.

3.9 CONTINUITY OF PROTECTION

During installation of the system, there shall be no loss of function of the existing base fire alarm system, or of the local building alarm systems connected thereto. Transfer of local alarm system connections from the existing base alarm system shall not result in loss of alarm transmitting or receiving capability. Temporary interruption of individual building alarm connections, not to exceed 8 hours duration, will be permitted at the discretion of the Contracting Officer. Interruption of alarm or communications functions at the fire alarm watch office is prohibited.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1995) Operating Salt Spray (Fog) Testing Apparatus

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 SAFETY REQUIREMENTS

1.5.1 Equipment Safety

Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

1.5.2 Warning Sign

Provide a permanent placard or sign at the entrance to confined spaces contained in the equipment. The sign shall warn personnel not to enter the space until the atmosphere inside has been tested and systems have been de-energized.

1.5.3 Lockout of Energy Sources

Provide appropriate lockout devices for energy isolating valves and for machines or other equipment to prevent unexpected start-up or release of stored electrical, mechanical, hydraulic, pneumatic, thermal, chemical, or other energy in accordance with 29 CFR 1910.147. Lockout devices for valves shall provide a means of attachment to which, or through which, a lock can be affixed or shall have a locking mechanism built into it so that the valve cannot be moved from the lockout position until the lock is removed. Electrical isolation of machines or other equipment shall be in accordance with requirements of DIVISION 16 "Electrical."

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 16402, "Interior Distribution System." Furnish internal wiring for components of packaged equipment as an integral part of the equipment.

Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16402, "Interior Distribution System."

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 3 mm on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, submit certifications that the manufacturer's standard factory painting system conforms to the heat resistance requirement in addition to other certifications.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 50 degrees Cshall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 50 Degrees C: Immediately after cleaning, the metal surfaces subject to temperatures less than 50 degrees C shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat.

b. Temperatures Between 50 and 205 Degrees C: Metal surfaces subject to temperatures between 50 and 205 degrees C shall receive two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm.

c. Temperatures Greater Than 205 Degrees C: Metal surfaces subject to temperatures greater than 205 degrees C shall receive two coats of 315 degrees C heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm.

-- End of Section --

SECTION 15081

EXTERIOR PIPING INSULATION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(1996; Rev. A) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 547	(1995) Mineral Fiber Preformed Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

1.2 SYSTEM DESCRIPTION

Provide field-applied insulation for exterior steam piping, existing insulated piping affected by Contractor's operation, and exterior condensate piping.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Insulation

b. Jacket

1.3.2 SD-06 Instructions

a. Installation manual for field-applied insulation

1.4 RECYCLED MATERIALS

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum recycled material content of he following insulation are:

Rock Wool - 75 percent slag by weight
Fiberglass - 20-25 percent glass cullet by weight
Phenolic Rigid Foam - 5 percent recovered material
Plastic Rigid Foam - 9 percent recovered material
Polyisocyanurate/Polyurethane - 9 percent recovered material
Rigid Foam - 9 percent recovered material

PART 2 PRODUCTS

2.1 PIPING INSULATION

Products containing asbestos will not be permitted.

2.1.1 Fibrous Glass Pipe Insulation

ASTM C 547.

2.1.2 Mineral Fiber Pipe Insulation

ASTM C 547.

2.1.3 Calcium Silicate Pipe Insulation

ASTM C 533.

2.1.4 Cellular Glass Pipe Insulation

ASTM C 552.

2.1.5 Polyurethane and Polyisocyanate Pipe Insulation

ASTM C 591, minimum density of 27.20 kilograms per cubic meter (kg/cu m).

2.1.6 Mineral Fiber Pipe Wrap Insulation

ASTM C 547 for material, minimum density of 36.80 kg/cu m.

2.2 MINIMUM THICKNESS OF INSULATION FOR STEAM PIPING

2.2.1 Fibrous Glass Pipe Insulation

Nominal Pipe Sizes (mm)	Aboveground Piping Insulation Thickness (mm)	Piping in Trenches on Piers Insulation Thickness (mm)
less than 80	88.90	63.50
80 thru 100	101.60	76.20
125 thru 150	114.30	88.90

Nominal Pipe Sizes (mm)	Aboveground Piping Insulation Thickness (mm)	Piping in Trenches on Piers Insulation Thickness (mm)
200 and larger	127.00	101.60

2.2.2 Mineral Fiber Pipe Insulation

Mineral fiber pipe insulation having an insulating efficiency not less than that of the specified thickness of fibrous glass pipe insulation may be provided in lieu of fibrous glass pipe insulation.

2.2.3 Mineral Fiber Pipe Wrap Insulation

Mineral fiber pipe wrap insulation having an insulating efficiency not less than that of the specified thickness of fibrous glass pipe insulation may be provided in lieu of fibrous glass pipe insulation for pipe sizes 250 mm and larger.

2.3 ALUMINUM JACKET

ASTM B 209M, Temper H14, minimum thickness of 0.40 mm, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 200 mm. Provide corrugated surface jackets for jacket outside diameters 200 mm and larger. Provide stainless steel bands, minimum width of 13 mm. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges.

2.4 ASPHALT-SATURATED FELT

ASTM D 226, without perforations, minimum weight of 0.49 kilograms per square meter.

2.5 STAINLESS STEEL JACKET

ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 0.25 mm, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 13 mm. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges.

PART 3 EXECUTION

3.1 INSTALLATION

Obtain Contracting Officer's written approval of piping systems prior to the application of insulation. Insulation shall be clean, dry, and installed prior to the application of insulation jacket. Do not use short pieces of insulation and jacket materials where a full length section will fit. Provide insulation materials and jackets with smooth and even surfaces, with jackets drawn tight, and secured on longitudinal and end laps. Insulate fittings and piping accessories with premolded, precut, or field-fabricated pipe insulation of the same pipe insulation material and thickness as the adjoining pipe insulation. Provide unions, flanges, valves, and piping accessories with removable (snap-on) sections of insulation. Provide insulation continuous through pipe hangers and pipe supports. Do not step on or walk on insulation or jacket.

3.2 PIPING INSULATION

3.2.1 Fibrous Glass Pipe Insulation

Install in accordance with the manufacturer's recommendations.

3.2.2 Mineral Fiber Pipe Insulation

Install in accordance with the manufacturer's recommendations.

3.2.3 Mineral Fiber Pipe Wrap Insulation

Install in accordance with the manufacturer's recommendations.

3.3 INSULATION JACKET

Provide new piping insulation and existing piping insulation affected by Contractor's operations with aluminum jacket. Machine cut the jacket to produce a straight, smooth edge. Lap longitudinal and circumferential seams not less than 50 mm. Install jackets on horizontal piping with the longitudinal seam approximately midway between horizontal centerline and the bottom side of pipe. Install with the top edge of jacket overlapping the bottom edge of jacket and with the seam of each jacket offset from the seam of the adjacent jacket. Install jackets on vertical piping and on piping pitched from the horizontal from low point to high point so that the lower circumferential edge of each jacket overlaps the jacket below it. Provide factory prefabricated covers for insulation on fittings, valves, and flanges. Finish jackets neatly at pipe hangers and pipe supports. Terminate jackets neatly at the ends of unions, valves, traps, and strainers. Secure jacket with stainless steel bands spaced not more than 200 mm on center.

3.3.1 In Pier Stainless Steel Jacket

In addition to the above requirements for aluminum jackets, secure longitudinal and circumferential seams with stainless steel screws spaced not more than 100 mm on centers. At approximately every 6 linear meter of piping, lap the circumferential seams not less than 150 mm; omit the screws.

3.4 ASPHALT-SATURATED FELT

Apply felt with longitudinal and circumferential seams lapped not less than 150 mm. Secure with not less than 13 mmwidth stainless steel bands spaced not more than 200 mm on center.

-- End of Section --

SECTION 15192

FUEL OIL PIPING
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1996) Scheme for the Identification of Piping Systems
ANSI B18.2.1	(1996) Square and Hex Bolts and Screws Inch Series

AMERICAN PETROLEUM INSTITUTE (API)

API STD 599	(1994) Metal Plug Valves - Flanged and Welded Ends
API RP 1615	(1996) Installation of Underground Petroleum Storage Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME/ANSI B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ASME B31.1	(1995) Power Piping
ASME B31.3	(1996) Process Piping

ASME/ANSI B31.4	(1992) Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols
ASME BPVC SEC VIII D1	(1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1
ASME BPVC SEC IX	(1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
ANSI/AWS Z49.1	(1994) Safety in Welding, Cutting and Allied Processes

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-1689	(Rev. B) Tape, Pressure-Sensitive Adhesive, (Plastic Film)

FEDERAL SPECIFICATIONS (FS)

FS L-C-530	(Rev. C) Coating, Pipe, Thermoplastic Resin
FS L-T-1512	(Rev. A Reinst) Tape, Pressure Sensitive Adhesive, Pipe Wrapping

MILITARY SPECIFICATIONS (MIL)

MIL-PRF-907	(Rev. E; Am. 2) Antiseize Thread Compound, High Temperature
MIL-C-18480	(Rev. B) Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-T-22361	(Am. 1) Thread Compound; Antiseize, Zinc Dust-Petrolatum

MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide
MIL-T-27730	(Rev. A) Tape, Antiseize, Polytetrafluoroethylene, with Dispenser

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-72	(1992) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic")

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Material and Methods" applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Carrier Piping

Piping which contains fuel oil, exclusively.

1.3.2 Secondary Containment System

System which contains carrier piping and prevents fuel leakage from carrier piping into surrounding soil and/or water. System may be either boxed-in trench or double-walled piping.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.4.1 SD-02 Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Pumps G

d. Expansion Joints G

e. Dielectric unions

1.4.2 SD-08 Statements

a. Welding procedure

b. Qualification of welders

c. List of welder's names and symbols

1.4.2.1 Welding Procedure

Before performing welding, submit three copies of welding procedure specification for metals included in the work, together with proof of its qualifications as outlined in ASME B31.1.

1.4.2.2 Qualification of Welders

Before welder or operator performs welding, submit to the Contracting Officer three copies of the Welder's Performance Qualification Record in conformance with ASME B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor.

1.4.2.3 List of Welder's Names and Symbols

Submit each welder's assigned number, letter, or symbol which shall be used to identify the work of the welder and shall be affixed immediately upon completion of the weld.

1.4.3 SD-13 Certificates

a. Dielectric unions

b. Coating materials

c. Coating application procedure

d. Expansion Joints

1.4.4 SD-19 Operation and Maintenance Manuals

a. Pumps, Data Package 3

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

1.5.1 Defective Welds

Welders making defective welds after passing a qualification test shall be required to take a re-qualification test. Welders failing the re-qualification tests will not be permitted to work under this contract.

1.5.2 Previous Welder Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without re-qualification, subject to approval by the Contracting Officer provided that all the conditions specified in ASME B31.1 are met before a procedure can be used.

1.6 WELDING SAFETY

ANSI/AWS Z49.1.

1.7 REGISTRATION

Contractor shall obtain required tank registration or permit/approval application forms from governing regulatory agencies. Furnish completed forms to the Contracting Officer and the installation environmental office within 10 days after contract award for their submission to the regulatory agency.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Steel Pipe and Fittings (DFM Piping)

2.1.1.1 Pipe

ASTM A 53, Schedule 40, black steel, electric-resistance welded or seamless.

2.1.1.2 Threaded and Socket-Welding Fittings

ASME B16.11, forged steel, Class 2000.

2.1.1.3 Threaded Fittings

ANSI/ASME B16.3, black malleable iron, Class 150.

2.1.1.4 Butt-Welding Fittings

ASME/ANSI B16.9, Class 150. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.

2.1.1.5 Flanges and Flange Fittings

ASME/ANSI B16.5, steel flanges or convoluted steel flanges which meet the criteria of ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross section which afford containment for self-energizing gasket material.

2.1.2 Vent Piping

ASTM A 53 standard weight, zinc-coated steel with zinc-coated malleable iron fittings ANSI/ASME B16.3.

2.1.3 Valves

2.1.3.1 Ball Valves

MSS SP-72 for flanged or butt-welding ends and MSS SP-110 for threaded, socket-welding, solder joint, grooved and flared ends.

2.1.3.2 Plug Valves

Cast-Steel API STD 599, PTFE seat, non-lubricated full port, square head, UL listed.

2.1.4 Piping Accessories

2.1.4.1 Unions

ASME/ANSI B16.39, Class 150 pound.

a. Dielectric Unions: Union comprised of steel female pipe thread end and copper solder-joint end conforming to dimensional, strength, and pressure requirements of ASME/ANSI B16.39, Class 1. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, it shall be able to withstand a 600-volt breakdown test.

2.1.4.2 Welding Filler Metal

ASME/ANSI B31.4 and compatible with the materials to be welded.

2.1.4.3 Brazing Filler Metal

AWS A5.8, silver base alloy, with melting point not less than 593 degrees C.

2.1.4.4 Hangers, Supports, and Shields

Design, selection, fabrication, installation, and spacing shall conform to MSS SP-58 and MSS SP-69. Hangers, supports, rods, anchors, nuts, bolts, and washers shall be hot-dip galvanized. Hangers and supports shall be of the adjustable type.

2.1.4.5 Gaskets

Provide one piece, factory cut, 1.60 mm thick, gaskets resistant to the effects of fuel oil and manufactured of fire-resistant materials. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

2.1.4.6 Bolting

Material for bolts and studs ASTM A 307, Grade-B and for nuts ASTM A 194/A 194M, Grade-2. Dimensions of bolts, studs and nuts ANSI B18.2.1 and ASME/ANSI B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

2.1.4.7 Identification for Piping Aboveground

Labels for pipes 20 mm diameter and larger shall bear printed legends to identify contents of pipes and arrows to show direction of flow. Labels shall have color coded background to signify levels of hazard in accordance with ANSI A13.1. Legends and type and size of characters shall also conform to ANSI A13.1. Make labels of plastic sheet CID A-A-1689 with pressure sensitivity suitable for intended applications, or they may be premolded of plastic to fit over pipe. For pipes smaller than 20 mm diameter, provide brass identification tags 40 mm in diameter with legends in depressed black filled characters.

2.1.4.8 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 80 mm minimum width, yellow in color with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED FUEL OIL PIPING BELOW" or similar wording. Provide permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with printed side up at a depth of 300 mm below top surface of earth or top surface of subgrade under pavements.

2.1.4.9 Miscellaneous Metal

ASTM A 36/A 36M, standard mill finished structural shapes, hot-dip galvanized after fabrication.

2.1.4.10 Bellows Expansion Joints

Provide Type 304 stainless steel bellows, internal and external guides, external protective cover, low point threaded drain, and ASME/ANSI B16.5, Class 150 flanged end connections. Provide limit stops to limit total movement in both directions. Cold set the joints to compensate for temperature at time of installation. Design to withstand 10,000 cycles over a period of 20 years, and for minimum working pressure of ANSI Class 150. Provide bellows expansion joint as indicated. Provide pipe alignment guides as indicated.

2.1.5 Protective Coating Systems for Underground Steel Piping

2.1.5.1 Underground Piping and Fittings

Provide protective coating system on steel carrier piping when direct buried.

a. Piping: New steel pipe shall receive protective coating system of factory-applied adhesive undercoat and continuously extruded polyethylene coating conforming to FS L-C-530, minimum thickness of plastic resin shall be 0.91 mm for pipe sizes 150 mm and larger, and 0.58 mm for pipe sizes under 150 mm.

b. Fittings and Other Surfaces: Fittings, couplings, regular surfaces, damaged areas of extruded polyethylene coating and existing piping affected by the Contractor's operations shall be protected by the application of tape. Surfaces to be tape wrapped shall be clean, dry and grease free. Tape conforming to FS L-T-1512 and of the type specified below shall be applied over a primer compatible with the tape and the extruded polyethylene coating.

(1) Fittings, Couplings, and Regular Surfaces: Tape shall be initially stretched sufficiently to conform to the surface to which it is applied, using one layer lapped at least 25 mm. Tape shall overlap the extruded polyethylene coated piping 80 mm at all joints. A second layer, lapped at least 25 mm, with a tension as it comes off the roll shall be applied and pressed to conform to the shape of the component. Tape shall conform to FS L-T-1512, Type II, 0.51 mm nominal thickness. Do not wrap joints until

completion of pressure testing.

(2) Damaged Areas of Extruded Polyethylene Coating: Residual material from coating shall be pressed into the break or trimmed off. Tape shall be applied spirally and one-half lapped as it is applied. Tape shall extend 80 mm beyond the damaged area. A double wrap of one full width of tape shall be applied at right angles to the pipe axis in a manner to seal each end of the spiral wrapping. Tape shall conform to FS L-T-1512, Type II, 0.51 mm nominal thickness.

(3) Existing Piping Affected by the Contractor's Operation: Wrap to 80 mm beyond the point of connection.

c. Flanges, Valves, and Irregular Surfaces: These items shall receive coal tar base coating conforming to MIL-C-18480 applied to a minimum dry film thickness of 0.76 mm.

2.1.5.2 Cathodic Protection

Underground coated steel piping shall have cathodic protection with test stations as specified in Section 13111 "Cathodic Protection by Impressed Current".

2.1.6 Protective Coating Materials for Aboveground Pipe

Coatings shall be the products of one manufacturer and coating application procedure shall be in accordance with manufacturer's instruction.

2.1.6.1 External Coatings

Protect aboveground piping against atmospheric corrosion with a coat of organic, lead and chromate free, zinc-rich primer conforming to SSPC Paint 20, Type II applied to a minimum dry film thickness of 0.102 mm and finish with two coats of epoxy-polyamide topcoat conforming to MIL-P-24441. Apply a gray first topcoat conforming to MIL-P-24441/2, Formula 151 applied to a minimum dry film thickness of 0.076 mm and finish with a white second topcoat conforming to MIL-P-24441/3, Formula 152 applied to a minimum dry film thickness of 0.076 mm resulting in a total system minimum dry film thickness of 0.28 mm.

2.2 Oily Waste Pipe and Fittings

Provide piping and fittings in accordance with Section 11312, "Package Grinder Pump Lift Station".

2.2.1 Pumps

Provide pumps as indicated and in accordance with Section 11312, "Package Grinder Pump Lift Station".

PART 3 EXECUTION

3.1 INSTALLATION

Contractor shall provide installation of fuel oil piping system in accordance with applicable Federal, State, regional or local regulations.

3.1.1 Fuel Oil Piping System

Install piping in out-of-the-way locations, in a manner that will minimize cutting of beams, girders, columns, or load-bearing members. Underground piping shall also conform to API RP 1615.

3.1.1.1 Underground Piping

a. Install underground fuel lines in a single trench with a bed of well-compacted non-corrosive material such as cleaned, washed sand at least 150 mm deep.

b. Trenches shall be wide enough to permit at least 150 mm of backfill between underground fuel lines and the sides and floor of the trench. Provide cover of at least 150 mm.

3.1.2 Pipe Sleeves

Provide sleeves where piping passes through walls. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls. Provide not less than 25 mm space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Secure plates to pipes at sleeves.

3.1.3 Steel Piping

Steel piping 50 mm and smaller shall be threaded or socket-welded. Steel piping 65 mm and larger shall be buttwelded. Flanges may be used for valves and equipment installation. Piping joints shall conform to ASME B31.3. Direct buried piping connections shall be welded.

3.1.4 Threaded Joints in Piping

Provide lubricant or polytetrafluoroethylene tape conforming to MIL-T-27730 on male threads of screwed joints. Red or white lead and zinc compound conforming to MIL-T-22361 may be used. Lubricate threaded pipe joints, as well as bolts and studs used on high temperature pipe joints up to 566 degrees C, with anti-seize compound in accordance with MIL-PRF-907. Piping shall be free from fins and burrs. Ream or file out pipe ends to size of bore and remove chips. Attach screwed flanges by screwing the pipe through the flange, and reface pipe and flange accurately.

3.1.5 Welding

3.1.5.1 Welding of Piping

Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually examined and meet acceptance standards specified in Chapter VI of ASME B31.1.

3.1.5.2 Quality of Welds

Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.

3.1.5.3 Arc Welding and Gas Welding

In accordance with ASME BPVC SEC IX.

3.1.6 Unions and Flanges

Place unions and flanges where necessary to permit easy disconnection of piping and apparatus. Each connection having a threaded end valve shall have a union.

3.1.7 Valves

Install valves in positions accessible for operation and repair.

3.2 FIELD QUALITY CONTROL

Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated test gage in the system. Maintain test pressure for at least one hour. In the event of leakage, locate and repair leak by rewelding and repeat test. Materials and equipment shall be subject to inspection at the installation site by the Contracting Officer.

3.2.1 Piping Test

Before backfilling of pipe trenches, perform hydrostatic test of fuel oil piping at 1 1/2 times system pressure or 689 kPa (gage) whichever is greater.

3.2.2 Protective Coating Systems

Inspect protective coating systems, with a holiday tester just prior to placement in ground. Holidays revealed shall be promptly repaired. Steel piping coating system shall be given a holiday test with a voltage of 100 to 200 times the mm thickness of the coating.

3.2.3 Cathodic Protection

Test to prove continuity of electrical connections prior to backfill.

-- End of Section --

SECTION 15194

AVIATION FUEL DISTRIBUTION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API SPEC 5L	(1995) Line Pipe
API SPEC 6D	(1994) Pipeline Valves (Gate, Plug, Ball, and Check Valves)
API STD 607	(1993) Fire Test for Soft-Seated Quarter-Turn Valves
API RP 1110	(1997) Pressure Testing of Liquid Petroleum Pipelines
API BULL 2209	(1978) Pipe Plugging Practices

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME/ANSI B16.34	(1988) Valves - Flanged, Threaded, and Welding End
ASME/ANSI B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995; Addenda 1995 and 1996) Power Piping
ASME B31.3	(1997) Process Piping
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 105/A 105M	(1996) Carbon Steel Forgings for Piping Applications
ASTM A 193/A 193M	(1996; Rev. B) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 234/A 234M	(1996; Rev. B) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM D 229	(1996) Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS A5.1	(1991) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.5	(1996) Low-Alloy Steel Arc Welding Electrodes for Shielded Metal Arc Welding

FEDERAL SPECIFICATIONS (FS)

FS L-C-530	(Rev. C) Coating, Pipe, Thermoplastic Resin
FS L-T-1512	(Rev. A Reinst) Tape, Pressure Sensitive Adhesive, Pipe Wrapping

MILITARY SPECIFICATIONS (MIL)

MIL-V-12003	(Rev. F; Am. 1) Valves, Plug: Cast Iron or Steel, Manually Operated

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1997) Flammable and Combustible Liquids

	Code
NFPA 70	(1996) National Electrical Code
NFPA 407	(1996) Aircraft Fuel Servicing

1.2 DEFINITIONS

In ASME B31.3 and NFPA 30 publications, the advisory provisions shall be considered mandatory, as though the work "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" and "owner" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Pipe

b. Valves

c. Expansion joints

d. Strainers

e. Protective coatings

f. Fittings

Submit manufacturer's data including specifications and performance test data. For fuel pumps, include actual diameter of impeller being furnished and manufacturer's certified pump test curves showing the characteristics over the entire operating range.

1.3.2 SD-04 Drawings

a. Aviation fuel distribution

1.3.2.1 Drawing Content

Submit drawings showing aviation fuel distribution including types, sizes, location, and installation details for:

a. Pipe hangers and supports

b. Bonding

c. Cathodic protection system

1.3.3 SD-06 Instructions

a. Expansion joints

b. Protective coatings

1.4 QUALIFICATIONS OF WELDERS

Each welder shall be qualified by test using equipment, procedures and a base metal and electrode or filler wire from the same compatible group number that will be encountered in field welding. Procedures and welders shall be qualified in accordance with Section IX, ASME Boiler and Pressure Vessel Code. Welders qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the test shall be performed at the work site if practicable. The Contracting Officer shall be furnished a copy of qualified procedures and a list of names and identification symbols of qualified welders. The welder shall apply his assigned symbol near each weld he makes as a permanent record.

1.5 REGULATORY REQUIREMENTS

Conform to the safety and fire regulations of the Station Fire Department when work is in progress. Obtain a "Hot Work" permit each day before performing welding or burning.

1.6 CATHODIC PROTECTION

Provide cathodic protection in accordance with Section 13111, "Cathodic Protection by Impressed Current."

PART 2 PRODUCTS

2.1 CARBON STEEL PIPING

2.1.1 Pipe

ASTM A 53, Type E (electric-resistance welded, Grades A or B) or Type S (seamless, Grade A or B), black steel; Weight Class STD (Standard) for pipe sizes larger than 50 mm, Weight Class XS (Extra-Strong) for pipe sizes 50 mm and smaller.

2.1.2 Line Pipe

API SPEC 5L, seamless, submerged-arc weld or gas metal-arc weld; Grade B, black steel, Weight Class STD (Standard) for pipe sizes larger than 50 mm, Weight Class XS (Extra-Strong) for pipe sizes 50 mm and smaller.

2.2 FITTINGS FOR CARBON STEEL PIPING

2.2.1 Threaded Fittings and Socket Welding Fittings

ASME B16.11. Threaded fittings may conform to ANSI/ASME B16.3, Class 150.

2.2.2 Buttwelding Fittings and Tapered Reducing Fittings

ASME/ANSI B16.9, ASTM A 234/A 234M, Type WPB, of the same material and weight as the piping in which fittings are installed. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.

2.2.3 Flanges

ASME/ANSI B16.5, Class 150, Raised Face Type, ASTM A 105/A 105M.

2.2.4 Unions

ASME/ANSI B16.39, Class 150.

2.3 WELDING FOR CARBON STEEL PIPING

2.3.1 Process for Carbon Steel

ASME B31.3, metallic arc process. Ten percent of welds shall be examined by radiography; if 25 percent of the radiographed welds fail, 100 percent of welds shall be examined by radiography.

2.3.2 Welding Electrodes

AWS A5.1 or AWS A5.5, E70XX low hydrogen electrodes.

2.4 GASKETS, BOLTS, NUTS AND WASHERS

2.4.1 Gaskets

ASME B16.21, composition ring 1.60 mm thick, of one piece factory cut, resistant to the effects of aviation hydrocarbon fuels and manufactured of fire-resistant materials. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints.

2.4.2 Bolts

ASTM A 193/A 193M, Grade B8. Extend no less than two full threads beyond the nut with the bolts tightened to the required torque.

2.4.3 Nuts

ASTM A 194/A 194M, Grade 8.

2.4.4 Washers

ASTM F 436M, flat circular stainless steel washers. Provide washers under bolt heads and nuts.

2.4.5 Electrically Isolating (Insulating) Gaskets for Flanges

Provide ASTM D 229 electrical insulating material of 1000 ohms minimum resistance. Material shall be resistant to the effects of aviation hydrocarbon fuels. Provide full face insulating gaskets between flanges. Provide full surface 0.76 mm thick wall thickness, spiral-wound mylar insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3.20 mm thick high-strength phenolic insulating washers next to flanges and flat circular stainless steel washers over insulating washers and under bolt heads and nuts. Provide bolts 13 mm longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts.

2.4.6 Electrically Isolating Unions

Provide with same electrical insulating materials as specified for electrically isolating flanges.

2.5 VALVES

Steel body except stainless steel shall be Type 304L or Type 316, and aluminum alloys shall be 3003, 6061-T6, or 356-T6, except as modified in paragraph entitled "Special Requirements," in this section, suitable for working pressure of ANSI Class 150 1896 kPa (gage) at 38 degrees C, with weatherproof housing designed to exclude driving rain and snow for worm-gear operators. Flanged end connections, except as modified herein. Nonaluminum sizes smaller than 50 mm and aluminum sizes smaller than 25 mm may have union end connections, or threaded end connections with a union on all but one side of the valve. Viton or Teflon with metal backup seals.

2.5.1 Ball Valves

API SPEC 6D, ANSI Class 150, full bore. Conform to fire test requirements of API STD 607. Provide nonlubricated double seated type capable of handling two-way shutoff, with weather-proof worm-gear operators, except valves 150 mm and smaller may be lever operated with 10 positions or infinitely adjustable positions between full open and full close. Balls in valve sizes 350 mm and larger shall have trunnion type support bearings. Valves in carbon steel piping shall have steel bodies with chromium-plated or nickel-plated steel balls. Valves in stainless steel piping and aluminum piping shall have Type 316 stainless steel bodies and balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals.

2.5.2 Plug (Double Block and Bleed) Valves

API SPEC 6D and MIL-V-12003 Type III, ANSI Class 150, nonlubricated, resilient, double seated, tapered lift, plug type capable of handling two-way shutoff; steel body, chrome-plated interior, and tapered plug of steel or ductile iron, chrome or nickel plated, supported on upper and lower trunnions, and steel or ductile iron, sealing slips, with Viton seals. Valve design shall permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves shall have weatherproof operators with mechanical position indicators and a minimum bore size of 65 percent of nominal pipe size, unless the manufacturer can show an equivalent or greater flow rate with a lower percent percent internal cross sectional area.

2.5.2.1 Valve Operation

Rotation of the handwheel toward open shall lift the plug without wiping the seals and retract the sealing slips so that clearance is maintained between the sealing slips and the valve body. Rotation of the handwheel toward closed shall lower the plug after the sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, the slips shall form a secondary fire-safe metal-to-metal seat on both sides of the resilient seal.

2.5.2.2 Relief Valves

ANSI Class 150, steel body. Provide plug valves with automatic thermal relief valves to relieve the pressure buildup in the internal body cavity when the plug valve is closed. Relief valves shall open at 175 kPa differential pressure, and discharge to the throat of and to the upstream side of the plug valve.

2.5.2.3 Bleed Valves

ANSI Class 150, steel body valve. Provide manually operated bleed valves that can be opened to verify that plug valves are not leaking when in the closed position. Provide discharge piping so that released liquid can be contained.

2.5.3 Plug (PTFE Sieved Tapered Plug) Valves

API SPEC 6D and MIL-V-12003 Type IV, ANSI Class 150, non-lubricated. Valve shall have stainless steel body at plug and shall have 360 degree port defining lips to retain the sleeve against deforming into the flow passages, provide abrasion protection, and prevent fuel entry behind sleeve. Plug shall operate with a 90 degree turn for closure.

2.5.4 Check Valves

ASME/ANSI B16.34, ANSI Class 150, steel body, except as modified herein. Spring-loaded, nonsurge globe type with fully guided (top and bottom) disc with Viton renewable seats.

2.6 PIPING ACCESSORIES

2.6.1 Pipe Hangers and Supports

MSS SP-58 and MSS SP-69, of the adjustable type, except as modified herein or indicated otherwise. Provide steel pipe hangers and supports. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dip galvanized.

2.6.1.1 Pipe Protection Shields

MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Provide at each slide type pipe hanger and support.

2.6.1.2 Low Friction Supports

Supports shall have self-lubricating antifriction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.05 mm under allowable static loads. Bond between material and steel shall be heat cured, high temperature epoxy. Design pipe hanger and support elements for the loads applied. Antifriction material shall be a minimum of 2.30 mm thick. Steel supports shall be hot-dip galvanized. Units shall be factory designed and manufactured.

2.6.1.3 Miscellaneous Metal

ASTM A 36/A 36M, standard mill finished structural steel shapes, hot-dip galvanized.

2.6.1.4 Anchors, Bolts, Nuts, Washers and Screws

Hot-dip galvanized steel, except provide Type 316 stainless steel bolts, nuts, washers, and screws under piers.

2.6.2 Strainers

Provide 'S' or 'T' pattern, duplex type, except as modified herein. Flanged end connections shall be designed in accordance with ASME/ANSI B16.5, Class 150; steel bodies, except Type 304 or 316 stainless steel, and 3003, 6061, or 356-T6 aluminum alloys. Strainers shall have removable baskets of 7-mesh, Type 316 stainless steel wire screen unless other mesh is indicated. Pressure drop for clean strainer shall not exceed 21 kPa (gage) at design flow rates. Provide strainer with air eliminator.

2.6.3 Gages

ANSI/ASME B40.1, single style pressure gage for fuel with 114 mm dial, brass or aluminum case, bronze tube, stainless steel ball valve, pressure snubbers, and scale range for the intended service.

2.6.4 Bellows Expansion Joints

Provide Type 304 stainless steel bellows, internal and external guides, external protective cover, low point threaded drain, and ASME/ANSI B16.5, Class 150 flanged end connections. Provide limit stops to limit total movement in both directions. Cold set the joints to compensate for temperature at time of installation. Design to withstand 10,000 cycles over a period of 20 years, and for minimum working pressure of ANSI Class 150. Provide bellows expansion joint as indicated. Provide pipe alignment guides as indicated.

2.6.5 Pipe Sleeves

Provide where piping passes through walls. Provide sleeves of sufficient length to pass through entire thickness of walls with a minimum 25 mm clearance between exterior of piping and interior of sleeve or core-drilled hole. Seal space with a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, calk both ends of pipe sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.7 PROTECTIVE COATINGS FOR PIPING

2.7.1 Protective Coatings for Aboveground Carbon Steel Piping

Paint shall conform to requirements of Section 09900, "Paints and Coatings," and shall be rated for use on hot metal surfaces up to 232 degrees C and for surfaces exposed to the weather. Color of finish coat shall be aluminum or light gray.

2.7.2 Coatings For Underground Piping

Protective Coatings for Buried Carbon Steel Piping and for Piping In Piers: Provide pipe with FS L-C-530coating system of factory-applied adhesive undercoat and continuously extruded plastic resin coating; minimum thickness shall be 0.90 mm for pipe sizes 150 mm and larger.

2.7.3 Damaged Areas of Pipe Coating

Provide FS L-T-1512, 0.50 mm nominal thickness tape over damaged areas.

2.7.4 Fittings, Couplings, and Regular Surfaces

Provide FS L-T-1512, 0.25 mm nominal thickness tape overlapped a minimum 25 mm over damaged areas.

2.8 BONDING

NFPA 70 for materials and workmanship. The fuel piping system shall be bonded in metallic contact to provide electrical continuity to fixed and moving components for grounding the entire system. Provide jumpers to overcome the insulating effects of gaskets, paints, or nonmetallic components. Minimum size ground conductor shall be No. 6, with single covered, flexible, stranded, copper conductor, Type RR-USE. Provide dielectric connection in riser pipe for undergound piping protected by impressed current.

2.9 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in minimum 80 mm width rolls, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Demolition

Remove materials so as not to damage materials which are to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction. The Government will drain the existing piping insofar as practicable with the existing pumps. The Contractor shall be responsible for removing the remaining fuel and sludge, and for cleaning and inerting the piping to make it safe for welding.

3.1.2 Protection

Portions of the work must be accomplished on piping suspended beneath the pier deck; therefore, it is imperative that the Contractor take precautions to guard against the spillage of fuel on to the pier or into the water.

3.2 INSTALLATION

Provide exterior aviation fuel distribution systems including above ground piping, buried piping, piping in manholes, dispensing hardware and related work. Install piping straight and true to bear evenly on supports. Install valves with stems horizontal or above. Install flanges and unions at valves, connections to equipment, and where indicated. The work includes installing piping up to and including the pumping equipment and valves within each building. Provide each system complete and ready for operation. Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.3 and NFPA 30, except as modified herein.

3.2.1 Protection Against Hazardous Conditions

The piping and the surrounding area shall be inspected for explosive vapors prior to work and frequently during the course of the work. If, in the opinion of the Contracting Officer, a hazardous condition exists, work shall cease until such condition has been corrected.

3.2.2 Safety

NFPA 30 and NFPA 407; safety rules shall be strictly observed. The flash points of fuels in degrees Centigrade are as follows:

FUELS	FLASH POINT
Jet Fuel JP-5	Plus 60

3.2.3 Connections To Existing Systems

Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; receive approval before interrupting service. Provide materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required.

3.2.4 Cutting Existing Pipe

Perform the initial cutting of the existing piping with a multiwheel pipe cutter, using a nonflammable lubricant. After cutting, seal the interior of the piping with a gas barrier plug in accordance with API BULL 2209. The interior of the piping shall be purged with carbon dioxide or nitrogen during welding process. The complete method of cutting, sealing, and welding shall be approved in advance of the actual work.

3.2.5 Cleaning of Piping

Keep the interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.3 PIPE AND FITTINGS

Inspect, test, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Reducing branch connections in steel piping may be made with forged branch outlet reducing fittings for branches two or more pipe sizes smaller than mains. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Stab type connections are prohibited. Jointing compound for pipe threads shall be polytetraflouroethylene (PTFE) pipe thread paste or PTFE powder and oil. Pipe nipples 150 mm long and shorter shall be Schedule 80 pipe. Make changes in piping sizes through tapered reducing pipe fittings.

3.3.1 Fittings and End Connections

Install threaded fittings and end connections for sizes less than 25 mm; threaded or socket-welding or buttwelding fittings and end connections for sizes 25 to 50 mm; threaded connections for threaded valves, traps, strainers, and threaded connections to equipment; buttwelding fittings and end connections for sizes 65 mm and larger; and flanged connections for flanged valves, traps, strainers, and flanged connections to equipment.

3.3.2 Pipe Hangers and Supports

Install additional hangers and supports for the concentrated loads in piping between hangers and supports, such as for valves. Install ASTM A 36/A 36M miscellaneous steel shapes as required. Support piping as follows:

Nominal Pipe Size (mm)	One and Under	40	50	80	100	150	200	250	300
Maximum Hanger Spacing (meters)	2	2.75	3	3.5	4.25	5	5.75	6.50	7.0

3.3.3 Anchors, Bolts, Nuts, Washers, and Screws

Install where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified shall be as required.

3.4 PROTECTIVE COATING

3.4.1 Damaged Materials

Fittings, couplings, irregular surfaces, damaged areas of pipe coating, and existing piping affected by the Contractor's operations shall be clean, dry, grease free, and primed before application of tape. Waterproof shrink sleeves may be provided using electric heating method in lieu of tape and shall overlap the pipe coating not less than 150 mm. Pipe coating and adhesive undercoat surfaces to be wrapped with tape shall be primed with a compatible primer prior to application of tape. Primer shall be as recommended by tape manufacturer and approved by pipe coating manufacturer. Apply pipe coating on piping in piers with finish paint coat as approved by pipe coating system manufacturer.

3.4.2 Pipe Coating

Residual material from pipe coating shall be pressed into the break or trimmed off. Apply tape spirally with one-third overlap as tape is applied. A double wrap of one full width of tape shall be applied at right angles to the axis to seal each end of the spiral wrapping.

3.4.3 Fitting Coating

Stretch and apply first layer of tape to conform to component's surface. Apply and press a second layer of tape over first layer of tape.

3.4.4 Flange, Valve and Irregular Surface Coating

Apply coal tar base coating to a minimum dry film thickness of 0.80 mm.

3.5 CATHODIC PROTECTION

Install cathodic protection systems for buried metallic piping systems. Final adjustments for impressed current systems shall be accomplished by a certified National Association of Corrosion Engineer (NACE).

3.6 BURIED UTILITY WARNING

Warning tape shall read "CAUTION BURIED FUEL PIPING BELOW" or similar wording. Bury tape with the printed side up at a depth of 300 mm below the top surface of earth or the top surface of the subgrade under pavements.

3.7 NAMEPLATES

Attach laminated plastic nameplates to equipment, gages, thermometers, and valves. Nameplates shall be Melamine plastic, 3 mm thick, black with white center core, matte finish surface and square corners. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be minimum of 6 mm high normal block style. Key the nameplates to a chart and schedule for each system. Frame charts and schedule under glass, and locate where directed near each system. Furnish two copies of each chart and schedule. Each nameplate inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number;

b. Contract number and acceptance date;

c. Capacity or size;

d. System in which installed; and

e. System which is controlled.

3.8 FIELD QUALITY CONTROL

3.8.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.8.2 Piping Tests

Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements.

3.8.2.1 Pneumatic Test

Pneumatically test each piping system to 172 kPa (gage), examine joints with soap solution. Gradually increase to 345 kPa (gage) and hold for 1 hour. The pneumatic test is more hazardous than a hydrostatic test, therefore, special safety measures, including the waring of face masks, shall be taken during testing under pressure. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing.

3.8.2.2 Hydrostatic Tests

Upon completion of pneumatic testing, hydrostatically test each piping system at 1.5 times maximum system operating pressure but in no case more than 1896 kPa (gage) in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gage pressure for 4 hours. Thoroughly flush piping before placing in operation. Flush piping, including branch piping, at a minimum velocity of 2.40 meters per second. Correct defects in work provided by the Contractor and repeat tests until work is in compliance with contract requirements. Furnish electricity, instruments, connecting devices, and personnel for the tests. Government will furnish fuel testing and flushing. Contractor shall be responsible for losses greater than 10 percent.

3.8.3 Testing of Protective Coatings

Perform tests with an approved silicone rubber electric wire brush or an approved electric spring coil flaw tester. Tester shall be equipped with an operating bell, buzzer, or other audible signal which will sound when a holiday is detected at minimum testing voltage equal to 1000 times the square root of the average coating thickness in mils. Tester shall be a type so fixed that field adjustment cannot be made. Calibration by tester manufacturer shall be required at 6-month intervals or at such time as crest voltage is questionable. Maintain the battery at ample charge to produce the crest voltage during tests. Areas where arcing occurs shall be repaired by using material identical to original coating or coating used for field joints. Upon completion of installation, retest the exterior surfaces, including field joints, for holidays. Promptly repair holidays.

3.8.4 Equipment Acceptance Tests

3.8.5 System Acceptance Test

3.9 FIELD PAINTING

After completion of field inspections and tests, clean and paint carbon steel surfaces exposed to the weather and in manholes, including valves, strainers, traps, flow meters, piping flanges, bolts, nuts, washers, pipe hangers, supports, expansion joints, and miscellaneous metal. Do no paint stainless steel or aluminum surfaces. Clean surfaces to remove dust, dirt, rust, oil, and grease. Apply two coats of enamel paint to a total minimum dry film thickness of 0.051 mm. Apply the second coat of paint after the preceding coat is thoroughly dry.

-- End of Section --

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SECTION 15700

HEATING, VENTILATING, AND COOLING SYSTEM
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI APD	(1995) Applied Products Directory
ARI 380	(1990) Packaged Terminal Heat Pumps

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(1995) Power Piping
ASME/ANSI B31.5	(1992; Errata 1993) Refrigeration Piping

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1042	(1994) Electric Baseboard Heating Equipment

1.2 SYSTEM DESCRIPTION

Provide new heating, ventilating, and cooling (HVAC) systems complete and ready for operation. HVAC systems include equipment, ducts, and piping which is located within, on, under, and adjacent to buildings.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Packaged terminal heat pumps

b. Electric baseboard units

1.3.2 SD-06 Instructions

a. Installation manual

1.3.2.1 Installation Manual

Provide for each item of equipment.

1.3.3 SD-19 Operation and Maintenance Manuals

a. Packaged terminal heat pumps, Data Package 2

b. Electric baseboard units, Data Package 5

Submit in accordance with Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 EQUIPMENT

Equipment using refrigerants R-11, R-12, R-113, R-114, R-115, R-500, or refrigerants with ozone depletion factor (ODF) greater than 0.05 shall not be permitted.

2.1.1 Packaged Terminal Heat Pumps

Provide units factory assembled, designed, tested, and rated in accordance with ARI 380. Units shall be ARI certified or rated in ARI APD. Units shall include refrigeration section, additional heating section (where indicated), separate outdoor weatherproof anodized aluminum louvers, forced ventilation, room cabinet, fans and motors, controls, wall sleeves, filters, dampers, grilles, subbases, leveling device, and power connections. Wall sleeves and installation shall be designed to exclude driving rain. Insulate interior of unit with manufacturer's standard insulation. Unit shall have slide-out chassis easily removed through room cabinet opening. Provide adjustable deflection inside air supply grille. Fan motors shall be permanent-split capacitor type.

a. Filters: Provide permanent washable air filters or UL listed throwaway fiberglass filters, standard dust-holding capacity; removable through access door or panel.

b. Safety controls: Provide compressor motors with thermal and overload protection, 5 minute anti-recycle timer, start capacitor kit, and crankcase heater. The above safety controls are not required when scroll compressors are provided.

c. Supplemental heating section: Provide UL or ETL listed electric resistance heaters including internal fusing integral with unit; fan shall run until heater cools. Provide controls to operate heater only when indoor thermostat is in heating mode and outdoor thermostat indicates outside temperature is below 1.7 degree C or unit balance point, whichever is higher; and when unit is in defrost mode at any outside temperature.

d. Space temperature controls: Provide controls including adjustable COOLER-WARMER temperature control thermostats with COOL-OFF-HEAT system switch and HIGH-MEDIUM-LOW fan switch, and FAN ONLY switch.

e. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 0.038 mm minimum dry film thickness. Rating of units shall be prior to application of phenolic coating.

2.2 ELECTRIC BASEBOARD UNITS

UL 1042; wattage, voltage, phase, heat in watts output indicated. Provide units complete with heating elements, mounting brackets, end closures, splice plates, interior and exterior corners and accessible wiring compartment. Limit outlet air temperature and enclosure surfaces to 93 degrees C under continuous operating conditions.

2.2.1 Enclosure

Fabricate from steel or aluminum not less than 18 gage. Provide factory applied rust-inhibiting paint manufacturer's standard finish. Locate terminal blocks for branch circuit conductor as required. Wiring shall conform to NFPA 70.

2.2.2 Limit Control

Provide thermal overload and over voltage protection.

2.2.3 Disconnect Means

Provide factory-installed safety disconnect switch in combination with thermostat with "off" position marking on the face plate.

2.2.4 Unit Thermostat

Provide tamper resistant integral tool adjustable thermostat, without requiring removal of cabinet parts. Thermostat, operating range shall be approximately 10 degrees C to a maximum of 24 degrees C with operating differential of 0.5 degrees C or less.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 HVAC System

Installation of HVAC system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, ASME/ANSI B31.5, NFPA 70, and in accordance with the manufacturer's recommendations. Connect to electrical supply in accordance with Section 16402, "Interior Distribution System."

3.2 ADJUSTMENTS

Adjust controls and equipment so as to give satisfactory operation. Adjust entire water temperature control system and place in operation so that water quantities circulated are as indicated. Air duct systems shall be adjusted and balanced so that air quantities at outlets are as indicated and so that distribution from supply outlets is free from drafts and has uniform velocity over the face of each outlet.

3.3 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by Contracting Officer, provide services of competent technician for period of not less than one 4-hour working day for instruction of Government operating personnel in proper operation and maintenance of equipment.

3.4 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

3.5 Insulation Resistance Tests

Test 600-volt wiring to verify that no short circuits or grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts and provides a direct reading of resistance in ohms.

-- End of Section --

SECTION 16001

DIVISION 16 SUBMITTAL REDUCTION PROCEDURES
06/98

PART 1 GENERAL

1.1 SUBMITTALS

1.1.1 Submittal Reduction

Specification sections listed in this section have manufacturers' products that may be selected for submittal reduction. If listed manufacturer's products are selected, the Government will waive the submittal requirements specified in the applicable specification sections, except for SD-06 Instructions, SD-19 Operation and Maintenance Manuals, and other noted exceptions. These other noted exceptions will be indicated with the section title and the manufacturer's product in Part 2 of this specification section.

1.1.2 Unused Submittal Reduction

The Contractor may use other non-listed products. If the Contractor chooses to use a product which complies with the requirements of the specification but is not listed for submittal reduction, the Contractor shall provide all submittals required in the specification section in accordance with Section 01330, "Submittal Procedures".

1.2 SUBMITTAL REDUCTION REQUIREMENT

Submittals for each specification section in Division 16, which list manufacturer's name and model numbers in this section may be reduced by providing a letter stating which one of the listed manufacturers will be utilized on the project. To accomplish this, provide an original letter on official stationary with a signature by a principal of the company, referencing this project by name, contract number, specification number, specification section, manufacturer's name and model number. The letter must have the QC Manager stamp of approval.

1.3 PRECEDENCE

The use of this specification section allows alterations to the normal submittal procedures, however, these modifications do not eliminate other unaffected requirements of Section 01330, "Submittal Procedures". Submittal procedures of this specification section take precedence over the procedures noted in Section 01330, "Submittal Procedures". Procedures specified in Section 01330 which are not affected by this specification section remain in effect.

PART 2 PRODUCTS

2.1 SECTION 16272, "THREE-PHASE PAD-MOUNTED TRANSFORMERS"

Submittal Reduction instructions for pad-mounted transformers are contained in Section 16272.

2.2 SECTION 16303, "UNDERGROUND AND UNDERPIER ELECTRICAL WORK"

2.2.1 Medium Voltage Cable

2.2.1.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

a. 15kV Cable

Manufacturer's Name	Manufacturer's Model No.
1. Pirelli Cable Corp. Greenwood, SC	Power Cable Model Eprotenax Insulation Type MV-90
2. Rome Cable Corp. Rome, NY	Rome-EPR Power Cable MV-90
3. Southwire Company Carrollton, GA	Power Cable Model 13ET for 15kV EPR Insulation Type MV-90

2.2.1.2 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

a. 35 kV Cable, tape shielded, 133% insulation

Manufacturer's Name	Manufacturer's Model No.
1. Pirelli Cable Corp. Greenwood, SC	Power Cable Model Eprotenax Insulation Type MV-90
2. Rome Cable Corp. Rome, NY	Rome-EPR Power Cable MV-90
3. Southwire Company Carrollton, GA	Power Cable Model 21 ET for 35kV, Type MV-90

2.2.2 Medium Voltage Cable Terminations

2.2.2.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

a. Porcelain Terminations

Manufacturer's Name	Manufacturer's Model No.
1. 3M Electrical Products Div. Austin, TX	Porcelain Termination Kits, Scotchcast Brand 5900 Series, 15kV.
2. G&W Electric Co.	Porcelain Slip-On II

Blue Island, IL	Terminations, S71BZAK1 Series, 15kV.

2.3 SECTION 16360, "SECONDARY UNIT SUBSTATIONS"

2.3.1 Transformers (Liquid Filled)

Submittal Reduction instructions for the transformer section of the secondary substations are contained in Section 16360.

2.4 SECTION 16403, "ELECTRICAL DISTRIBUTION SYSTEM"

2.4.1 Switches

2.4.1.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

a. Toggle Switches

Manufacturer's Name	Manufacturer's Model/Series
1. Leviton Manufacturing Co. Little Neck, NY	AC Quiet Wall Switches CS120-21 Series.
2. Arrow Hart Wiring Devices Syracuse, NY	CS Switches CS120I Series.
3. Bryant Electric Milford, CT	Industrial Grade, AC Quiet Switches, 1121 Series.
4. Hubbel Wiring Device Div. Bridgeport, CT	Specification Grade 1121

b. Disconnect Switches

Manufacturer's Name	Manufacturer's Model/Series
1. General Electric	Spec Setter Type TG General Duty Spec Setter Type TH Heavy Duty.
2. Square D	General Duty Class 3130 Heavy Duty Class 3110.
3. Westinghouse	General Duty Types GFN and GUN Heavy Duty Types HFN and HUN

2.5 SECTION 16511, "LIGHTING"

2.5.1 Fluorescent Lamps

2.5.1.1 Manufacturers' Information

The following manufacturers' names and model numbers comply with the project specifications requirements.

a. 32 Watt T8 Rapid Start Fluorescent Lamp (48")

Manufacturer's Name	Manufacturer's Model No.
1. GE Lighting Cleveland, OH	F32T8/SP35
2. Osram Sylvania, Inc. Danvers, MA	F032/735
3. Philips Lighting Co. Somerset, NJ	F32T8/TL735

2.5.2 High Pressure Sodium Lamps

2.5.2.1 Manufacturers' Information

Manufacturer's Name	Manufacturer's Series
1. GE Lighting Cleveland, OH	Lucalox
2. Osram Sylvania, Inc. Danvers, MA	Lumalox
3. Philips Lighting Co. Somerset, NJ	Ceramalux

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709	(1992) Laminated Thermosetting Material

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100	(1996) Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Construction," Division 13, "Special Construction," and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 34,500/19,920 kV primary, three phase, four wire, 60 Hz, and 208Y/120 volts secondary, three phase, four wire; 34,500 volts primary, three phase, three wire, 60 Hz, and 120/240 volts secondary, single phase, three wire; 480Y/277 volts secondary, three phase, four wire; and 125 volts dc, two wire. Final connections to the power distribution system at the existing substation and manhole shall be made by the Contractor as directed by the Contracting Officer.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of section entitled "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 355 by 510 mm in size using a minimum scale of 1 mm per 100 mm. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01781, "Operation and Maintenance Data" and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be a minimum of 6.35 mm high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including pad-mounted transformers, having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with ANSI C57.12.28, such as for pad-mounted transformers, provide a self-adhesive warning sign on the outside of the high voltage compartment doors. Sign shall be a decal and shall have nominal dimensions of 178 mm by 255 mm with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 50 mm high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 355 by 255 mm with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 75-mm high white letters on a red and black field.

1.10 CABLE TAGS IN MANHOLES, CABLE WELLS, AND CABLE ROOMS

Provide tags for each cable or wire located in manholes, cable wells, and cable rooms. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The first position on the tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

1.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 22.4 MPa; and that are two millimeter thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C. Provide 1.3 mm (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 778.75 N. The cable tags shall have black block letters, numbers, and symbols 25 mm high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.11.1 Motors and Equipment

Provide motors, controllers, integral disconnects, and contactors with their respective pieces of equipment. Motors, controllers, integral disconnects, and contactors shall conform to Section 16403, "Electrical Distribution System". Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

1.11.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment under Section 16403, "Electrical Distribution System." Power wiring and conduit shall conform to Section 16403, "Electrical Distribution System." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09900, "Paints and Coatings" or the section specifying the associated electrical equipment.

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 9 meters apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, cable well, and cable room as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, cable wells, and cable rooms.

-- End of Section --

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SECTION 16081

APPARATUS INSPECTION AND TESTING
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1995) Electrical Power Distribution Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-08 Statements

a. Qualifications of organization, and lead engineering technician G

b. Acceptance test and inspections procedure G

1.3.1.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for

Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.3.1.2 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

1.3.2 SD-12 Field Test Reports

a. Acceptance tests and inspections G

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 16272, "Three-Phase Pad-Mounted Transformers"

b. Section 16303, "Underground and Underpier Electrical Work"

c. Section 16341, "SF6 Insulated Interrupter Switches"

d. Section 16343, "Station Type High Voltage Circuit Breaker and Air Switches and Accessories"

e. Section 16360, "Secondary Unit Substations"

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

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SECTION 16272

THREE-PHASE PAD-MOUNTED TRANSFORMERS
02/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.7	(1993) Watthour Meter Sockets
ANSI C12.15	(1990) Electricity Metering Solid-State Demand Registers for Electromechanical Watthour Meters
ANSI C12.16	(1991) Electricity Metering Solid-State Electricity Meters
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 117	(1996) Electrical Insulating Oils of Petroleum Origin
ASTM D 1535	(1996) Specifying Color by the Munsell System
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
ANSI/IEEE C57.12.00	(1993) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.26	(1992) Pad-Mounted, Compartmental-Type,

	Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, (34 500 Grd Y/19 920 V and Below; 2500 kVA and Smaller)
ANSI/IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers
ANSI/IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
ANSI/IEEE C57.13	(1993) Instrument Transformers
ANSI/IEEE C57.98	(1993) Guide for Transformer Impulse Tests
ANSI/IEEE C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1995) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," and Section 16081, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures." Code 404, Atlantic Division, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval. As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by GE in Shreveport, LA; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Routine and other tests (paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.

e. Provide field test reports (paragraph entitled "Field Test Reports").

f. Provide operation and maintenance manuals (paragraph entitled "Operation and Maintenance Manuals").

1.4.1 SD-01, Data

a. Transformer losses G

1.4.1.1 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses".

1.4.2 SD-02, Manufacturer's Catalog Data

a. Pad-mounted transformers G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

1.4.3 SD-04, Drawings

a. Pad-mounted transformer drawings G

1.4.3.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data (both the transformer unit and the transformer coil insulation BIL ratings shall be indicated).

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

1.4.4 SD-08 Statements

a. Year 2000 (Y2K) Compliance Warranty G

1.4.4.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.5 SD-11, Factory Test Reports

a. Pad-mounted transformer design tests G

b. Pad-mounted transformer routine and other tests G

1.4.6 SD-12, Field Test Reports

a. Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control" G

b. Ground resistance test reports G

1.4.6.1 Ground Resistance Test Reports

Upon completion and before energizing electrical equipment, submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin locations) used to determine ground resistance and soil conditions at the time the measurements were made.

1.4.7 SD-18, Records

a. Transformer test schedule G

1.4.8 SD-19, Operation and Maintenance Manuals

a. Transformer(s), Data Package 5 G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data" and as specified herein.

1.4.8.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 16303, "Underground and Underpier Electrical Work" and Section 16403, " Electrical Distribution System".

2.2 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems, solid-state controls, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.3 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.26, ANSI C57.12.28, and as specified herein.

2.3.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.3.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to dead-front surge arresters, tap changer handle, connector parking stands, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 35kV, 150 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts : IEEE 386, 200 amperes, 35 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. Load-break switch

   Radial-feed oil-immersed type rated at 35 kV, 150 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

d. Surge arresters: ANSI/IEEE C62.11, rated 27 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into bushing well inserts. Provide three arresters for radial feed circuits.

e. Parking stands: Provide a parking stand near each bushing well.

2.3.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

b. Metering: Provide a socket-mounted electronic programmable outdoor watthour meter, surface mounted flush against the side of the low-voltage compartment as indicated. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements and conform to ANSI C12.16.

   (1) Design: Provide meter designed for use on a 3-phase, 4-wire, 480Y/277 volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

   (2) Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

   (3) Class: 20; Form: 9S; Accuracy: +/- 1.0 percent; Finish: Class II

(4) Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

(5) Kilowatt-hour Register: 5 digit electronic programmable type

(6) Demand Register:

a) Provide solid state ANSI C12.15

b) Meter reading multiplier:

1) Indicate multiplier on the meter face.

c) Demand interval length: shall be programmed for 60 minutes with rolling demand up to six subintervals per interval.

(7) Meter fusing: Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

(8) Socket: ANSI C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box Munsell 7GY3.29/1.5 green to match the pad-mounted transformer to which the box-mounted socket is attached. The Munsell color notation is specified in ASTM D 1535.

(9) Current transformers: ANSI/IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide three current transformers per power transformer with characteristics listed in the following table.

kVA	Sec. Volt	CT Ratio	RF	Meter Acc. Class
500	480Y/277	600/5	3.0	0.3 thru B-0.5

2.3.2 Transformer

a. Oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 500 kVA, 200 kV BIL. (Test at 150 kV BIL)

c. Transformer voltage ratings: 34.5 kV - 480Y/277V.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than 4.0 percent at 85 degrees C.

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
500	56

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.3.2.1 Transformer Losses

No-load losses (NLL) shall be 886 watts at 20 degrees C and load losses (LL) shall be 3359 watts at 85 degrees C. The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values exceed the specified values by more than the tolerances allowed by Table 19 in ANSI/IEEE C57.12.00, the transformer is unacceptable.

2.3.3 Insulating Liquid

a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.3.4 Corrosion Protection

Entire transformer assembly including tank and radiator, base, enclosure, and metering enclosure shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Form enclosure of stainless steel sheets. Paint entire transformer assembly Munsell 7GY3.29/1.5 green. Paint coating system shall comply with ANSI C57.12.28. The Munsell color notation is specified in ASTM D 1535.

2.4 WARNING SIGNS

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.5 SOURCE QUALITY CONTROL

2.5.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Design Tests

ANSI/IEEE C57.12.00, and ANSI/IEEE C57.12.90. Section 5.1.2 in ANSI/IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s). Design tests shall have been performed prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (OA), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

(1) ANSI/IEEE C57.12.90, paragraph 10.3 entitled "Lightning

Impulse Test Procedures," and ANSI/IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.26.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.5.3 Routine and Other Tests

ANSI/IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

g. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and ANSI C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 16303, "Underground and Underpier Electrical Work." Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 16303, "Underground and Underpier Electrical Work."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4.1 Meters and Current Transformers

ANSI C12.1.

3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete platform as indicated. Coordinate platform size with size of transformer provided.

3.6 FIELD QUALITY CONTROL

3.6.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.6.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications

and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

(4) Verify correct liquid level in tanks.

(5) Perform specific inspections and mechanical tests as recommended by manufacturer.

(6) Verify correct equipment grounding.

(7) Test load tap-changer, if applicable.

b. Electrical tests

(1) Perform insulation-resistance tests.

(2) Perform turns-ratio tests.

(3) Sample insulating liquid. Sample shall be laboratory tested for:

(a) Dielectric breakdown voltage

(b) Acid neutralization number

(c) Specific gravity

(d) Interfacial tension

(e) Color

(f) Visual condition

(g) Water content

(h) Power factor

(4) Perform dissolved gas analysis (DGA).

(5) Test for presence of PCB.

3.6.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection of transformers with system requirements.

(4) Verify that adequate clearances exist between primary and secondary circuit wiring.

(5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

(6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

(1) Perform insulation-resistance test.

(2) Perform a polarity test.

(3) Perform a ratio-verification test.

3.6.1.3 Watthour Meter

a. Visual and mechanical inspection

(1) Verify that meter type, scales, and connections are in accordance with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Examine for broken parts and shipping damage.

(3) Verify tightness of electrical connections.

b. Electrical tests

(1) Calibrate watthour meters according to manufacturer's published data.

(2) Verify that correct multiplier has been placed on face of meter, where applicable.

3.6.1.4 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under

test. Resistance reading must not exceed values specified in Section 16303 "Underground and Underpier Electrical Work".

3.6.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 16301

OVERHEAD TRANSMISSION AND DISTRIBUTION
02/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 7	(1988; Rev. 1991, 1992, and 1996, R 1991) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

RURAL UTILITIES SERVICE (RUS)

RUS 202-1	(1996, Supplements 1996, 1997) List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers

UNDERWRITERS LABORATORIES INC. (UL)

UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. Cables G

1.3.2 SD-12 Field Test Reports

a. Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control" G

b. Ground resistance test reports G

1.3.2.1 Ground Resistance Test Reports

Upon completion and before energizing electrical equipment, submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements.

2.2 HARDWARE

Hot-dip galvanized conforming to ASTM A 153/A 153M.

2.3 AERIAL SECONDARY CABLES

Secondary cables shall be aluminum duplex with cross-linked polyethylene insulation on the phase conductors. Neutral shall be bare aluminum alloy and shall be the same size as the phase conductors unless otherwise indicated. Cables shall conform to NEMA WC 7 for cross-linked polyethylene insulation.

2.4 GROUND RODS

Provide ground rods as specified in Section 16303, "Underground and Underpier Electrical Work".

2.4.1 Grounding Conductors

Provide grounding conductors as specified in Section 16303, "Underground and Underpier Electrical Work".

2.5 CONDUCTORS

Provide conductors and terminations as specified in Section 16303, "Underground and Underpier Electrical Work".

2.6 ELECTRICAL TAPES

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes shall comply with UL 510.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

3.1.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests.

3.1.1.1 Grounding System

Provide testing as specified in Section 16303, "Underground and Underpier Electrical Work".

3.1.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

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SECTION 16303

UNDERGROUND AND UNDERPIER ELECTRICAL WORK
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB14	(1992; R 1994; Errata 1993) Highway Bridges
AASHTO LTS2	(1985; R 1994 with Revisions thru 1994) Structural Supports for Highway Signs, Luminaires and Traffic Signals
AASHTO M198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318M/318RM	(1992) Building Code Requirements for Reinforced Concrete with Commentary

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A36/A36M	(1997; Rev A) Carbon Structural Steel
ASTM A123/A123M	(1997; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 32	(1993) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 570	(1995) Water Absorption of Plastics
ASTM D 696	(1991) Coefficient of Linear Thermal Expansion of Plastics between -30 Degrees C and 30 Degrees C
ASTM D 2105	(1997) Longitudinal Tensile Properties of 'Fiberglass' (Glass-Fiber-Reinforced Thermosetting Resin)
ASTM D 2444	(1993) Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D 4097	(1995, REV A) Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS6	(1987; R 1989) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev. E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48	(1996) Alternating-Current Cable Terminations 2.5 kV Through 765 kV
IEEE 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V - 138,000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V - 500,000 V

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1995) Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing

NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
NEMA TC 14	(1984; R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
NEMA WC 8	(1988; Rev. 1992 and 1996) Ethylene-Propylene- Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	(1997) Rigid Metal Conduit
UL 44	(1997; Bul. 1997, R 1998) Thermoset-Insulated Wires and Cables
UL 94	(1996; R 1997) Flammability of Plastic Materials for Parts in Devices and Appliances
UL 96	(1994; R 1996; Bul 1995) Lightning Protection Components, Third Edition
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment
UL 486A	(1997; R 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; R 1997) Wire Connectors for Use with Aluminum Conductors
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 651	(1995; R 1997) Schedule 40 and 80 Rigid PVC Conduit

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" and Section 16081, "Apparatus Inspection and Testing" apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

b. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Submit the following in accordance with the Section 16001, "Submittal Reduction Procedures."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Fiberglass conduit G

b. Fiberglass conduit fittings G

c. Fiberglass conduit supports G

d. Fiberglass cable wells G

e. 2000 volt conductors G

f. Single-pole in-line power connectors G

g. Lightning masts G

h. Medium voltage cable G

i. Medium voltage cable terminations G

j. Medium voltage cable joints G

k. Live end caps G

l. Metal frames and covers G

m. Cable racks G

n. Sealing material for precast manhole and handhole joints G

o. Precast concrete manholes G

1.4.2 SD-04, Drawings

a. Precast concrete manhole drawings G

b. Cable Well Drawings G

1.4.2.1 Precast concrete manhole drawings

Provide calculations and drawings for each type of precast manhole bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings prepared in accordance with ACI 315

e. Plans and elevations showing opening and pulling-in iron locations and details

1.4.2.2 Cable Well Drawings

Provide drawings for cable wells including:

a. Material description (i.e., f'c and Fy)

b. Overall dimensions, weights, plan view, and front view

1.4.3 SD-08, Statements

a. Cable splicer/terminator G

b. Qualifications of fiberglass conduit manufacturer G

c. Fiberglass conduit manufacturer's warranty G

1.4.3.1 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.4.3.2 Qualifications of Fiberglass Conduit Manufacturer

Fiberglass conduit manufacturer shall be regularly employed in the manufacture of fiberglass-epoxy conduit and have a minimum of 3 years experience in manufacturing fiberglass-epoxy conduit in the United States. The date for determination of the experience claimed by the Contractor shall be the date specified for receipt of bids by the Contracts Division. Fiberglass conduit manufacturer shall submit the following information for verification of successful fiberglass epoxy conduit installation. The submittal shall include a minimum of three separate projects with the same quantity and quality of fiberglass-epoxy conduit as this project.

a. Installation location and mailing address

b. The installations' current facility manager and phone number

c. Installation completion date

d. System description including quantity and type of conduit

e. Prime Contractor's name, address, and current phone number

1.4.3.3 Fiberglass Conduit Manufacturer's Warranty

Furnish the fiberglass conduit manufacturer's warranty. The warranty shall be directly between the manufacturer and the Government. The warranty period shall not be less than 1 year from the date of conduit installation. The manufacturer shall warrant the fiberglass conduit and fittings.

1.4.4 SD-09, Reports

a. Arc-proofing test for cable fireproofing materials G

b. Medium voltage cable qualification and production tests G

1.4.5 SD-12, Field Test Reports

a. Field Acceptance Checks and Tests G

Identify each cable for 600-volt, and medium voltage cable tests. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin locations) used to determine ground resistance and soil conditions at the time the measurements were made.

1.4.6 SD-13, Certificates

a. 2000 volt conductor ampacity G

1.4.6.1 2000 Volt Conductor Ampacity

Provide certification from the manufacturer that minimum conductor ampacity in free air, based on 30 degree C ambient temperature, is 700 amperes.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit

UL 6, galvanized steel, threaded type.

2.1.1.2 Plastic Conduit for Direct Burial

NEMA TC 2, Type EPC-80-PVC.

2.1.1.3 Plastic Utilities Duct for Concrete Encasement

NEMA TC 6, Type EB.

2.1.1.4 Fiberglass Conduit

The conduit shall conform to the following:

a. Conduit size shall conform to NEMA TC 14, Section 2, Part B.

b. Tensile Strength: (axial) ultimate Stress 75.8 MPa at 23.9 degrees C tested per ASTM D 2105.

c. Coefficient of Thermal Expansion: Maximum of 1.8x10(-5) mm/mm/degree C, tested per ASTM D 696.

d. Water absorption: Less than 1% tested per ASTM D 570.

e. Flammability: HB Rating UL 94.

f. Impact Resistance: Provide Heavy Wall type tested per ASTM D 2444. Minimum impact resistance shall be as follows.

Conduit Size (mm)	Minimum Impact Resistance at 0 degrees C (Newton Meters)
53	54.2
78	94.9
103	162.7
155	271.2

g. Joints shall be made using adhesive providing pull out resistance of 4990 kg.

2.1.2 Fittings

2.1.2.1 Metal Fittings

UL 514B, threaded type.

2.1.2.2 PVC Conduit Fittings

NEMA TC 3 and UL 651.

2.1.2.3 PVC Duct Fittings

NEMA TC 9.

2.1.2.4 Fiberglass Conduit Fittings

NEMA TC 14. Expansion fittings shall be watertight, weatherproof, and shall permit a relevant movement of up to 150 mm longitudinally and 25 mm transversely.

2.1.3 Fiberglass Conduit Supports

Provide non-metallic conduit strut, conduit strut fittings, rigid conduit straps, and conduit strut hardware.

2.1.3.1 Conduit Struts

Conduit struts shall incorporate flange profile design which allows full and positive interlocking contact of strut accessories and prohibits premature flange failure from torqued accessories. Strut shall be manufactured of glass-reinforced polyester material. Strut shall be heavy duty (nominal profile of 42 mm square and 4.8 mm thick) and shall have a minimum pull out resistance of 3340 Newtons when load is applied over a 9.5

mm long section of the inside flanges. Conduit struts shall have a maximum deflection of 3 mm when 12,300 Newtons is applied to a 610 mm section of strut. Provide strut capping strips and end caps for use with concrete embedment struts to prevent the entrance of concrete inside of the strut.

2.1.3.2 Conduit Strut Fittings

Strut fittings shall be fabricated from 9.5 mm flat polyester material. Provide fittings with 10.3 mm holes which accommodate 9.5 mm hardware.

2.1.3.3 Rigid Conduit Straps

Rigid conduit straps shall be made from glass-reinforced polyurethane and sized based on the conduit nominal size. Conduit straps shall be rated for applications up to 70 degrees C and have minimum design loads of 1000 Newtons.

2.1.3.4 Conduit Strut Hardware

Provide conduit strut hardware as recommended by the conduit strut manufacturer. Hex bolts, washers, hex nuts, and strut nuts shall be manufactured from glass-reinforced polyurethane. Bolts shall have a minimum thread shear of 1100 Newtons and minimum shank shear of 2000 Newtons. Nuts shall have a minimum thread shear of 2000 Newtons. Heavy duty strut nuts shall have a minimum thread shear of 6200 Newtons.

2.1.4 4/0 and Smaller Wire and Cable

Wires and cables, No. 4/0 and smaller, rated 600 volts and less, shall be as specified in Section 16403, "Electrical Distribution System".

2.1.5 Conductors Greater than 4/0 Rated 2000 Volts and Less

Conductor sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

2.1.5.1 600 Volt Conductors

Conductors shall conform to UL 44, Type XHHW-2. Conductor size and number of conductors in each cable shall be as indicated. All conductors shall be stranded compact aluminum alloy listed or labeled by UL as "component aluminum wire stock (conductor material)" Type EC/1350 aluminum is not acceptable.

2.1.5.2 2000 Volt Conductors

Extra-flexible stranded annealed coated copper conductor, separator tape, ethylene-propylene rubber insulation, hypalon jacket, single conductor type DLO rated 2000 volts at maximum conductor temperature of 90 degrees C. Insulation and jacket shall conform to NEMA WC 8, except for the insulation and the jacket thickness. Insulation and jacket thickness shall be a minimum of 94 and 47 mils respectively. Conductors shall have a minimum of 1100 strands of No. 24 AWG. Conductor ampacity in free air, based on 30 degrees C ambient temperature, shall be 700 amperes, minimum.

2.1.5.3 Color Coding

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves.

a. Colors for coding conductors shall be:

480-VOLT SYSTEM

Neutral - White
Phase A - Brown
Phase B - Orange
Phase C - Yellow
Grounding Conductor - Green

2.1.6 600 Volt Wire Connectors and Terminals

Shall be rated 90 degrees C and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.

a. For use with Copper Conductors: UL 486A.

b. For use with Aluminum Conductors: UL 486B. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

2.1.7 Single-Pole In-Line Power Connectors

Provide in-line male connectors (plugs) and in-line female connectors (receptacles) rated for 500 volts, 500 amperes, 60 hertz, single-pole continuous duty operation. Plugs shall be compatible with Duraline standard latching ball nose receptacles. Connectors shall be color coded as follows:

CONNECTORS

Phase A - Red
Phase B - Black
Phase C - White

2.1.8 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

2.1.8.1 Cable Configuration

Cable for 34.5 kV underground and underpier distribution system shall be Ozone resistant ethylene-propylene-rubber-insulated (EPR) cable conforming to NEMA WC 8 and AEIC CS6. Cable shall be single conductor, employing concentric, Class B stranded copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal tape type consisting of a concentric serving of tape according to NEMA WC 8. Cable insulation level shall be 133%. Cable shall be rated 35 kV with insulation and jacket thickness of 420 and 80 mils, respectively for 4/0 cable and 420 and 110 mils, respectively for 750 Kcmil cable. Cable shall have a polyvinyl chloride jacket.

2.1.9 Medium Voltage Cable Terminations

IEEE 48 Class 1. Provide terminations including stress control terminator, ground clamp, connectors, and lugs. The terminator shall be the product of one manufacturer, suitable for the type and materials of the cable terminated. Furnish components in the form of a "UL listed" kit, including complete instructions which shall be followed for assembly and installation. Provide terminator as specified herein for terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV indoor and outdoor. Do not use separate parts of copper or copper alloy in contact with aluminum or aluminum alloy parts in the construction or installation of the terminator.

2.1.9.1 Outdoor Terminations

The outdoor terminator shall be cold shrink type or porcelain insulator type.

a. Cold-Shrink Type

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, Munsell gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C.

b. Porcelain Insulator Type

The terminator shall comply with requirements of IEEE 48 Class 1, except that the requirements of design tightness test need not be met. However, the terminator shall not exude any insulating filler compound under either test or service. The terminator shall consist of a porcelain insulator, copper cable connector-hoodnut assembly and copper aerial lug as required, metal body and supporting bracket, sealed cable entrance, internal stress relief device for shielded cable, and insulating filler compound or material.

2.1.9.2 Termination; Separable Insulated Connector Type

Provide as specified in Section 16272, "Three-Phase Pad-Mounted Transformers" Section 16341, "SF6 Insulated Interrupter Switches", and Section 16360, "Secondary Unit Substations".

2.1.10 Medium Voltage Cable Joints

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, and insulation type of the cable. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion. Connectors shall be rated for voltage of 35 kV minimum.

a. Heat-Shrinkable Joint: Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with waterproof mastic seal on both ends.

b. Watertight Taped-Type Joint: Consists of an approved connector, self-fusing or self-bonding insulating tape, self-fusing semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

2.1.11 Live End Caps

Provide live end caps using a "kit" including a heat-shrinkable tube and a high dielectric strength, polymeric plug overlapping the conductor. End cap shall conform to applicable portions of IEEE 48.

2.1.12 Tape

2.1.12.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.12.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 02315, "Excavation and Fill".

2.1.12.3 Fireproofing Tape

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than 0.762 mm thick by 76.2 mm wide, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.1.13 Pull Rope

Shall be plastic having a minimum tensile strength of 890 N.

2.1.14 Ground Rods

UL 467. Provide copper clad steel ground rods with diameter adequate to permit driving to full length of the rod, but not less than 19 mm in diameter. Ground rods shall be 3050 mm long unless otherwise indicated.

2.1.15 Grounding Conductors

Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG, except 34.5 kV cable sheaths and cable shields shall be grounded with No. 4/0 AWG.

2.1.16 Precast Concrete Manholes

In lieu of cast-in-place, the Contractor may, at his option, provide precast concrete manholes conforming to ASTM C 478M and ASTM C 478, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

a. General: Precast concrete manholes shall have the same accessories and facilities as described in the paragraph entitled "Cast-In-Place Manholes". Likewise, precast manholes shall have plan area and clear heights not less than those of cast-in-place manholes. Concrete materials and methods of construction shall be the same as for cast-in-place manholes, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 30 MPa. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or manholes may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

b. Design for Precast Manholes: ACI 318M/318RM. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

(1) Angle of Internal Friction (phi) = 0.523 rad

(2) Unit Weight of Soil (Dry) = 1760 kg/m3, (Saturated) = 2080 kg/m3

(3) Coefficient of Lateral Earth Pressure (Ka) = 0.33

(4) Ground Water Level = 915 mm below ground elevation

(5) Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB14.

(6) Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 26,700 N.

(7) Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

(8) Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

c. Construction: Structure top, bottom, and wall shall be of a uniform thickness of not less than 150 mm. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 305 mm vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 150 mm from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps for precast structures a minimum of 305 mm in diameter and 100 mm deep.

d. Joints: Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.1.16.1 Metal Frames and Covers

Provide cast iron frames and covers for manholes conforming to FS RR-F-621. Cast the words "ELECTRIC" and "TELEPHONE" in the top face of power and telephone manhole covers, respectively.

2.1.16.2 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C 32, Grade MS.

2.1.17 Fiberglass Cable Wells

Provide fiberglass cable wells as indicated. Cable wells shall be open top corrosion resistant fiberglass reinforced epoxy boxes with interior and exterior surfaces with ISO-NPG marine grade gelcoat finish. Cable wells shall be rated Class I fire resistant. Size shall be coordinated with the actual dimensions of openings in the precast concrete deck. The sides and bottom shall be a minimum of 6.35 mm thick. The top 150 mm of the sides shall be a minimum of 9.53 mm thick. All material and workmanship shall meet NBS PS 15-69 and ASTM D 4097. Each box shall be capable of supporting 2,873 Pa loading. Provide solid skid resistant fiberglass covers where indicated. Cover shall withstand service load of no less than 6,800 kg over 250 mm by 250 mm area.

2.1.18 Cable Racks (Brackets, Arms and Insulators)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.1.18.1 Wall Brackets

The wall bracket shall be 100 mm by approximately 38 mm by 4.76 mm channel steel, and length indicated in manholes. Slots for mounting cable rack arms shall be as indicated.

2.1.18.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of 200 mm and a maximum of 508 mm.

2.1.19 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.1.20 Cable Tags

Provide as specified in 16050, "Basic Electrical Materials and Methods."

2.1.21 Lightning Masts

2.1.21.1 Wind Loads

Provide masts designed for wind loading of 161 km/hr determined in accordance with AASHTO LTS2.

2.1.21.2 Structure

Mast shall consist of a round, tapered, free-standing, monotube shaft or telescoping sectioned shaft. Masts of heights up to 12 meters shall be of single section design, masts over 12 meters shall be multi-section design. The mast shall be fabricated from high-strength steel having a minimum yield strength of not less than 385 MPa.

2.1.21.3 End Plates

Mast shall have a steel plate at the top and anchor base welded to the bottom of the shaft. The base shall be secured to the shaft by continuous welds, one on the inside of the base at the bottom of the shaft and one on the outside at the top of the base. The anchor base shall be fabricated from structural steel conforming to ASTM A36/A36M, or approved equivalent.

2.1.21.4 Corrosion Protection

The entire assembly shall be hot-dip galvanized in accordance with ASTM A123/A123M after all construction.

2.1.21.5 Grounding Pads

Two grounding pads shall be welded at the base of the shaft above the anchor base and shall be spaced 180 degrees apart. Ground pads shall be tapped to receive 19 mm threaded bolts and shall conform to UL 96.

2.1.21.6 Anchor Bolts

Anchor bolts shall conform to the requirements for high-strength steel and shall be hot-dip galvanized in accordance with ASTM A153/A153M. Anchor bolts shall be sized per manufacturer's recommendations.

2.2 SOURCE QUALITY CONTROL

2.2.1 Arc-Proofing Test for Cable Fireproofing Materials

Manufacturer shall test one sample assembly consisting of a straight lead tube 305 mm long with a 65.5 mm outside diameter, and a 3.175 mm thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a DC power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

2.2.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS6 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Underground installation shall conform to ANSI C2 except as otherwise specified or indicated.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. Nonindicated utility lines found by the Contractor while scanning the construction site with electromagnetic or sonic tracing equipment will be treated as "indicated" utilities. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 20 MPa minimum ultimate 28-day compressive strength with 25-mm minimum aggregate conforming to the requirements of Section 03300, "Cast-in-Place Concrete."

3.1.3 Underground Conduit/Duct Without Concrete Encasement

The type of conduit shall be EPC-80-PVC or rigid metal conduit.

3.1.3.1 Conduit Installation

The top of the conduit shall be not less than 610 mm below grade, and shall have a minimum slope of 75 mm in each 30 meters away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. Terminate conduits in end-bells where they enter underground structures. As each conduit run is completed, draw a nonflexible testing mandrel not less than 305 mm long with a diameter 6 mm less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 75 mm clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 75 mm, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 6 mm sieve.

3.1.3.2 Multiple Conduits

Separate multiple conduits by a minimum distance of 50 mm, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 75 mm. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 3050 mm of conduit assembly.

3.1.4 Underground Duct with Concrete Encasement

Construct underground duct banks of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or specified, the conduit shall be PVC, Type EB. Do not mix different kinds of conduit in any one duct bank. Ducts shall be a minimum of 155 mm in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 75 mm of concrete cover around ducts. Separate conduits by a minimum concrete thickness of 65 mm, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 75 mm. Where indicated, reinforce ductbank with No. 16 bars along the top and bottom of encasement. Locate bars at corners and between conduit.

3.1.4.1 Depth of Encasement

The top of the concrete envelope shall be a minimum of 450 mm below grade, except under roads and pavement, concrete envelope shall be a minimum of 610 mm below grade.

3.1.4.2 Slope of Encasement

Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 75 mm in 30 meters. Except at conduit risers, changes in direction of runs exceeding a total of 0.175 rad, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 7.62 meters; sweep bends may be composed of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 455 mm for use with conduits of less than 75 mm in diameter and a minimum radius of 915 mm for ducts of 75mm in diameter and larger. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

3.1.4.3 Conduit

Terminate conduits in end-bells where ducts enter underground structures. Stagger the joints of the conduits by rows and layers to strengthen the duct bank. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 3050 mm of duct bank. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

3.1.4.4 Test Mandrel

As each section of a duct bank is completed from structure to structure, a testing mandrel not less than 305 mm long with a diameter 6 mm less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff-bristled brush, having the diameter of the conduit shall be drawn through until the conduit is clear of earth, sand, and gravel particles. Conduit plugs shall then be immediately installed.

3.1.4.5 Connections to Manholes

Duct bank envelopes connecting to underground manholes shall be flared to have an enlarged cross-section at the manhole entrance to provide additional shear strength. The dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 305 mm in each direction. The perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide for a positive interlock between the duct bank and the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure.

3.1.4.6 Connections to Existing Underground Manholes

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.1.4.7 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 610 mm back into the envelope and a minimum of 610 mm beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 305 mmapart. Restrain reinforcing assembly from moving during concrete pouring.

3.1.5 Underpier Conduit System

Underpier conduit system shall be fiberglass conduit, fittings, supports, and cable wells. Mount as indicated.

3.1.5.1 Expansion Joints for Fiberglass Conduit

Install in conduits where the conduits pass through structural expansion joints. An expansion joint with gasket shall be installed at least every 60 meters. For each run shorter than 60 meters provide at least one expansion joint.

3.1.6 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 915 mm of slack at each end of unused or empty conduits.

3.1.7 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.1.8 Installation of Warning and Identification Tape

Provide warning tape for underground direct buried, in conduit, and concrete encased systems. Bury tape with the printed side up at a depth of 305 mm below the top surface of earth or the top surface of the subgrade under pavements.

3.1.9 Cast-In-Place Underground Manholes

Manholes shall be standard type cast in place, as indicated, or may be of precast construction as described in the paragraph entitled "Precast Concrete Manholes". Horizontal concrete surfaces of floors shall have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C 309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground manholes shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete.

3.1.9.1 Cable Pulling-In Irons

Pulling-in irons shall be steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 150 mm from the edge of the sump, and in the walls the irons shall be located within 150 mm of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 150 mm of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 150 mm clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 915 mm length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 75 mm from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 100 mm and shall be designed to withstand a minimum pulling-in load of 26,700 N. Irons shall be hot-dipped galvanized after fabrication.

3.1.9.2 Cable Rack Installation

Cable brackets, arms and insulators shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 915 mm apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 420 mm apart with the end rack being no further than 305 mm from the adjacent wall. Methods of anchoring cable racks shall be as follows:

a. Provide a 15.8 mm diameter by 125 mm long anchor bolt with 75 mm cast in structure wall with 50 mm protrusion of threaded portion of bolt into structure. Provide 15.87 mm steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 1192 kg per meter. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 15.87 mm steel nuts in channel insert to receive 15.87 mm diameter by 75 mm long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 365 kg load rating. Provide 15.87 mm diameter by 75 mm long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.1.9.3 Grounding in Underground Manholes

Provide a No. 1/0 AWG bare copper cable on each interior sidewall. The cables shall be exothermically welded to the ground rod in the structure, and shall be accessible for future grounding requirements.

3.1.9.4 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be given a crystalline phosphate coating. As soon as practicable after the coating has dried, surfaces shall be primed with a coat of zinc-molybdate primer and one coat of synthetic exterior gloss enamel.

3.1.10 Precast Manhole Installation

Commercial precast structures shall be set on 150 mm of level, 90 percent compacted granular fill, 19 mm to 25 mm size, extending 305 mm beyond the structure on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator. Installation shall additionally conform to the manufacturer's instructions.

3.1.11 Cable Pulling

Test existing ducts with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.11.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.1.11.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.11.3 Installation of Cables in Underground Manholes

Do not install cables utilizing the shortest path, but route along those walls providing the longest path and the maximum spare cable lengths. Form cables to closely parallel walls, without interference to duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground manhole.

In existing manholes where new ducts are to be terminated or where new cables are to be installed, modify the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported in the same manner as specified for new cables.

3.1.11.4 Cable Markers (or Tags) in Underground Manholes

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

3.1.11.5 Conductors Installed in Parallel

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor, unless otherwise indicated.

3.1.12 2000 Volt and 600 Volt Cable Splicing and Terminating

Do not splice 2000 volt cable and 700 kcmil, 600 volt cable. Splice and terminate cables 4/0 and smaller in accordance with Section 16403, "Electrical Distribution System".

3.1.13 Medium Voltage Cable Terminations

Provide terminating devices and materials to protect medium voltage cable terminations from accidental contact, deterioration of coverings, and moisture. Make terminations by using materials and methods specified herein and as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Termination for high-voltage cables shall be rated, and be capable of withstanding test voltages, in accordance with IEEE 48. Terminations of single- and multiconductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Adequately support cables and cable terminations to avoid any excessive strain on the termination and the conductor connection.

3.1.14 Medium Voltage Cable Joints

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in locations indicated by using materials and methods specified herein and as designated by the written instructions of the cable manufacturer and the joint kit manufacturer. Size connectors properly for the cable being connected and crimp using a full circle compression tool.

3.1.14.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Insulate cable shield for 34.5 kV system splices into sections at each splice to prevent circulating currents in the shield. Ground each insulated section at one point only. Provide a bare copper ground connection brought out in a watertight manner and grounded to a ground rod as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.1.15 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.16 Live End Caps

Provide live end caps for single conductor medium voltage cables where indicated.

3.1.17 Fireproofing of Cables in Manholes

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in manholes and pier cable rooms.

3.1.17.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.1.18 Grounding Systems

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Distribution substations, switching stations primary distribution stations enclosed by fences, 1000 kVA or over	3 ohms
Pad-mounted transformers without protective fences	5 ohms
Ground in manholes and pier cable rooms	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms

Grounded secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution systems and grounds not otherwise covered	5 ohms

When work in addition to that indicated or specified is directed in order to obtain the specified ground resistance, the provisions of the contract covering "Changes" shall apply.

3.1.18.1 Grounding Electrodes

Provide cone pointed ground rods driven full depth plus 150 mm, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.18.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.18.3 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.1.18.4 Fence Grounding

Fences shall be grounded with a ground rod at each fixed gate post and at each corner post. Drive ground rods until the top is 305 mm below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 305 mm of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm by 25 mm flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.1.19 Special Conditions

During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition.

3.1.20 Excavating, Backfilling, and Compacting

Provide under this section as specified in Section 02315, "Excavation and Fill".

3.1.21 Reconditioning of Surfaces

3.1.21.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.21.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, make repairs in accordance with Section 02951 "Pavement Removal and Replacement."

3.2 FIELD QUALITY CONTROL

3.2.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.1.1 Conductors Rated 2000 Volts and Less

Perform tests after wiring is completed, connected, and ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed.

a. Visual and Mechanical Inspection

(1) Inspect cables for physical damage and proper connection in accordance with contract plans and specifications.

(2) Check cable color coding for compliance with contract specifications.

b. Electrical Tests

(1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts DC for 1 minute. Minimum insulation - resistance values shall not be less than 50 megohms.

(2) Perform continuity test to insure proper cable connection.

(3) Perform other tests as recommended by manufacturer for the 2000 volt cable.

3.2.1.2 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable supplied is in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) If cables are terminated through window-type CT's, make an inspection to verify that neutrals and grounds are properly terminated for proper operation of protective devices.

(7) Visually inspect jacket and insulation condition.

(8) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method; Record ohmic value, resistance values in excess of 10 ohms per 305 meters of cable must be investigated and justified.

(2) Perform a DC high-potential test on all cables. Adhere to precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Field acceptance test voltage for 35 kV cable shall be 103 kV DC.

(a) Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.

(b) Record wet- and dry-bulb temperatures or relative humidity and temperature.

(c) Test each section of cable individually.

(d) Individually test each conductor with all other conductors grounded; Ground all shields.

(e) Terminations shall be properly corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.

(f) Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or manufacturer's specifications.

(g) Apply the DC high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.

(h) Raise the conductor to the specified maximum test voltage and hold for fifteen (15) minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Provide a graphic plot of readings with leakage current (X axis) versus voltage (Y axis) at each increment.

(i) Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.

(j) Apply grounds for a time period adequate to drain all insulation stored charge.

(k) When new cables are spliced into existing cables, the DC high-potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice. After a satisfactory insulation-resistance test, a DC high-potential test shall be performed on the completed cable system utilizing a test voltage 75% of new cable tested value.

3.2.1.3 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.2.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

3.3 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
a. Fireproofing Tape		
- Thickness	30 mils	0.762 mm
- Width	3 inches	75 mm
b. Pull Wire		
- Tensile strength	200 pounds	890 Newton
c. Ground Rod		
- Diameter	3/4 inch	19 mm
- Length	10 feet	3050 mm
d. Concrete		
- Strength	3000 psi	20 MPa
- Strength	3500 psi	25 MPa
- Strength	4000 psi	30 MPa

-- End of Section --

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SECTION 16341

SF6 INSULATED INTERRUPTER SWITCHES
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 1535	(1996) Specifying Color by the Munsell System
ASTM D 2472	(1992, R 1997) Sulfur Hexafluoride

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

ANSI/IEEE 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
ANSI/IEEE C37.60	(1981; R 1992) Overhead, Pad-Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA C37.72	(1987) Manually-Operated, Dead-Front Pad-mounted Switchgear with Load Interrupting Switches and Separable Connectors for Alternating-Current Systems

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1995) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" and Section 16081, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.4.1 SD-02 Manufacturer's Catalog Data

a. Pad-mounted SF6 Insulated Interrupter Switch G

b. Vault-type SF6 Insulated Interrupter Switch G

Each submittal shall include data on switches and associated accessories.

1.4.2 SD-04 Drawings

a. Load Interrupter Switch Drawings G

1.4.2.1 Load Interrupter Switch Drawings

Furnish drawings that include, but are not limited to, the following:

a. Overall dimensions, weights, plan view, and front view

b. Ampere ratings of switch

c. Maximum short-circuit bracing

d. One-line diagram.

e. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the automatic vacuum fault interrupter.

1.4.3 SD-08 Statements

a. Year 2000 (Y2K) Compliance Warranty G

1.4.3.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.4 SD-11 Factory Test Reports

a. Load interrupter switch design and production tests G

1.4.5 SD-12 Field Test Reports

a. Acceptance Checks and Tests G

b. Ground resistance tests G

1.4.5.1 Ground Resistance Tests

Upon completion and before energizing electrical equipment, submit the measured ground resistance of grounding system. Include a description of the soil conditions at the time the measurements were taken where applicable.

1.4.6 SD-19 Operation and Maintenance Manuals

a. SF6 insulated interrupter switch, Data Package 5 G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems, solid state controls, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 SF6 INSULATED INTERRUPTER SWITCH

Provide pad-mounted and vault-type, SF6 insulated interrupter switch(es) conforming to ANSI/NEMA C37.72 and ANSI C57.12.28 and as specified herein. Load break interrupters and fault interrupters shall be vacuum interrupters.

2.2.1 Switch Configuration

Each switch shall be configured as indicated.

2.2.2 Switch Construction

SF6 switch(es) shall be shipped factory filled with SF6 gas conforming to ASTM D 2472. The following standard components shall be included:

a. Filling valve located in switching compartment with gage.

b. Lifting eyes

c. Viewing windows to permit inspection of loadbreak switch contacts

d. Indicators showing the position of the fault interrupter contacts.

e. Gas pressure gage in viewable location from switch operating handle.

f. Grounding provisions for one 15 mm by 13 NC ground connection per switch-way

g. Corrosion resistant tank design using stainless steel and brass fasteners with no external aluminum parts

h. One-line diagram and stainless steel nameplate fastened with stainless steel mechanical fasteners

i. Operating mechanism capable of being locked in any position, with position indication and removable operating handle

j. Connector parking stands for each bushing

k. Provisions for shunt tripping each individual fault interrupter switchway via remote contact devices for pad-mounted switches

2.2.3 Electrical Ratings and Standards

Switches shall be designed, tested, and built in accordance with ANSI/NEMA C37.72. Switch assembly shall be rated as follows:

Maximum design voltage, kV	38
Impulse level (BIL), kV (minimum)	150
Ac 1-minute withstand, kV (minimum)	70
Dc 15-minute withstand, kV (minimum)	100
Continuous current, A	600
Momentary current withstand, kA asym	20
Close-and-latch rating (3 times), kA asym	20
1-second symmetric current withstand, kA	12

2.2.4 Vacuum Interrupters

Vacuum interrupters shall be designed, tested and built in accordance with ANSI/IEEE C37.60. Manual closing shall be by a mechanical linkage assembly. This assembly shall provide for a "trip-free" operation which allows the vacuum interrupter to interrupt independent of the operating lever if closing into a faulted or heavily loaded phase or circuit. Manual load interruption shall be by an electrical operator. The vacuum interrupter assembly shall have an interrupting rating of 19,200 rms amperes asymmetrical at the voltage specified.

2.2.4.1 Fault Interrupters

Fault interrupters shall utilize internally mounted current transformers and programmable overcurrent control circuits with selectable time current trip characteristics to provide three-phase ganged trips for single and three phase faults.

2.2.4.2 Loadbreak Interrupters

Loadbreak interrupters shall provide manual three-phase operation of the vacuum interrupter.

2.2.5 Bushings

ANSI/IEEE 386. 35 kV, 150 kV BIL. Provide 600 ampere, one-piece deadbreak apparatus bushings.

2.2.6 Insulated High-Voltage Connectors

ANSI/IEEE 386. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors as indicated.

a. 600 Ampere deadbreak connector ratings: Voltage: 35 kV, 150 kV BIL. Short time rating: 27,000 amperes rms, symmetrical for a time duration of 4.0 seconds. Provide 200 Ampere interface connector (loadbreak reducing plug).

2.2.7 Grounding Elbows

ANSI/IEEE 386, rated 35 kV. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms, symmetrical for a time duration of 0.17 seconds. Each grounding elbow shall have a stainless steel pulling eye and a 600-volt insulated, stranded, copper ground cable. Provide one set of grounding elbows to be delivered to the contracting officer for each switch configured with two position switchways. Grounding elbows are not required for switches configured with three position (opened-closed-ground) switchways.

2.2.8 Corrosion Protection

Bases of vault-style switch, and bases and enclosures of pad-mounted switches, shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Paint bases and enclosures Munsell 7GY3.29/1.5 green. Paint coating system shall comply with ANSI C57.12.28. The Munsell color notation is specified in ASTM D 1535.

2.3 SOURCE QUALITY CONTROL

2.3.1 Load Interrupter Switch Design and Production Tests

Furnish reports which include results of design and production tests performed according to ANSI/NEMA C37.72. Production tests shall be performed by the manufacturer on each load interrupter switch to ensure that design performance is maintained in production.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and ANSI C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 16303, "Underground and Underpier Electrical Work."

3.2.2 Switch Grounding

Provide bare copper cable as indicated connected to the grounding provisions in each switch way.

3.2.3 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.3.1 Shore Sited Switch

Mount switch on concrete slab. Slab shall be at least 305 mm thick, reinforced with a 150 mm by 150 mm - D - 4 by D - 4 mesh, placed uniformly 100 mm from the top of the slab. Slab shall be placed on a 150 mm thick, well-compacted gravel base. Top of concrete slab shall be approximately 100 mm above finished grade. Edges above grade shall have 15 mm chamfer. Slab shall be of adequate size to project at least 200 mm beyond equipment.

Stub-up conduits, with bushings, 50 mm into cable wells in the concrete pad. Coordinate dimensions of cable wells with switch cable training areas. Concrete work shall be as specified in Section 03300, "Cast-in-Place Concrete."

3.3.2 Pier Deck Switches

Mount switch on platform as indicated.

3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Interrupter Switch(es)

a. Visual and Mechanical Inspection

(1) Inspect physical and mechanical condition

(2) Compare equipment nameplate information with approved shop drawings

(3) Check for proper anchorage, required area clearances, physical damage, and proper alignment

(4) Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware

(5) Inspect connections for tightness of bolted joints

(6) Perform mechanical operator tests in accordance with manufacturer's instructions

(7) Test interlock systems for proper operation and sequencing

(8) Clean entire assembly using approved methods and materials

(9) Verify proper phase barrier materials and installation

(10) Lubricate as required

(11) Inspect all indicating devices for proper operation

b. Electrical Tests

(1) Perform insulation-resistance tests

(2) Perform dc over-potential tests

(3) Perform vacuum bottle integrity test (over-potential) with the switch in the open position.

(4) Set fault interrupter circuit in accordance with government provided settings. Request settings from government in writing, a minimum of 30 days prior to scheduling electrical tests.

(5) Trip fault interrupters by operation of shunt trip provisions.

3.4.1.2 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected

ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that devices are in good operating condition and properly performing the intended function. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times for checks and tests.

-- End of Section --

SECTION 16343

STATION TYPE HIGH VOLTAGE CIRCUIT BREAKERS AND AIR SWITCHES, AND ACCESSORIES
04/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C12.1	(1995) Code for Electricity Metering
ANSI C37.06	(1997) AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
ANSI C37.46	(1981) Specifications for Power Fuses and Fuse Disconnecting Switches
ANSI C57.12.20	(1997) Transformers - Overhead-Type Distribution Transformers, 500 kVA and Smaller: High-Voltage, 34500 Volts and Below; Low-Voltage, 7970/13800Y Volts and Below
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 241	(1989) Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube, Spec for
ASTM D 117	(1996) Electrical Insulating Oils of Petroleum Origin
ASTM D 1535	(1996) Specifying Color by the Munsell System
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

ANSI/IEEE C37.2	(1979) Electrical Power System Device

	Function Numbers
ANSI/IEEE C37.12	(1991) AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Specifications Guide
ANSI/IEEE C37.32	(1996) High-Voltage Air Disconnect Switches, Interrupter Switches, Fault Initiating Switches, Grounding Switches, Bus Supports, and Accessories Control Voltage Ranges - Schedules of Preferred Ratings, Construction Guidelines and Specifications
ANSI/IEEE C37.35	(1992) Guide for the Application, Installation, Operation, and Maintenance of High-Voltage Air Disconnecting and Load Interrupter Switches
ANSI/IEEE C37.90	(1989) Relays and Relay Systems Associated with Electric Power Apparatus
ANSI/IEEE C37.90.1	(1989) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C57.12.00	(1993) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI/IEEE C57.13	(1993) Instrument Transformers
ANSI/IEEE C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1995) Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code
NFPA 70B	(1994) Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES INC. (UL)

UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," and Section 16081, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures".

1.4.1 SD-02, Manufacturer's Catalog Data

a. High-voltage vacuum circuit breakers G

b. High-voltage air interrupter switches G

c. High-voltage air disconnect switches G

d. Medium voltage cable terminations G

e. Surge arresters G

f. 34.5 kV outdoor bus G

g. Power fuses and fuse disconnecting switches G

h. Potential transformers G

i. Station service transformer G

j. Protective relays including manufacturers instruction bulletins and operating characteristic curves G

k. Lockout relays G

l. Control switches G

m. Indicating lights G

1.4.2 SD-04, Drawings

a. High-voltage vacuum circuit breakers G

b. High-voltage air interrupter switches G

c. High-voltage air disconnect switches G

d. Power fuses and fuse disconnecting switches G

e. Controlboard drawings G

1.4.2.1 Controlboard Drawings

Submit drawings for the Relay and Metering Controlboard. The drawings shall include the following:

a. Three-line diagrams.

b. Outline drawings including front elevation, section views, plan view, dimensions of equipment and locations of devices on equipment, shipping section splits, and weights.

c. AC and DC schematic diagrams.

d. Bill of materials. There shall be a direct and specific correlation between the bill of material and the schematic diagrams so that the items on the schematic diagrams may be easily identified on the bill of materials.

1.4.3 SD-08 Statements

a. Year 2000 (Y2K) Compliance Warranty G

1.4.3.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.4 SD-10, Test Reports

a. High-voltage vacuum circuit breaker design tests G

b. High-voltage vacuum circuit breaker production tests G

1.4.4.1 High-voltage vacuum circuit breaker design tests

ANSI/IEEE C37.12.

1.4.4.2 High-voltage vacuum circuit breaker production tests

ANSI/IEEE C37.12.

1.4.5 SD-12, Field Test Reports

a. Acceptance checks and tests G

1.4.6 SD-19, Operation and Maintenance Manuals

a. High-voltage vacuum circuit breakers, Data Package 5 G

b. High-voltage air interrupter switches, Data Package 5 G

c. High-voltage air disconnect switches, Data Package 5 G

d. Power fuses and fuse disconnecting switches, Data Package 5 G

e. Protective relays, Data Package 5 G

PART 2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems, solid-state devices and relays, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 HIGH-VOLTAGE VACUUM CIRCUIT BREAKERS

ANSI/IEEE C37.12. Provide station type, outdoor, three-pole, gang operated, vacuum, power circuit breakers for use on a three phase, 60 hertz, solidly grounded 34.5 kV system.

2.2.1 Circuit Breaker Ratings

The circuit breaker shall meet the preferred ratings listed in ANSI C37.06 and the following electrical characteristics:

Rated Maximum Voltage, kV	38
Insulation Level (BIL) Withstand, kV (minimum)	
Low-Frequency - Dry 1 minute	80
Full-Wave Impulse	200
Rated Continuous Current, A	1200
Rated Short-Circuit Current, A	31,500

2.2.2 Operating Mechanism Control Power

The breaker closing mechanism shall be 240 VAC motor-charged spring type. The breaker tripping mechanism shall be 125 VDC shunt trip type.

2.2.3.1 Auxiliary Switches

Provide eight (8), convertible from "a" to "b", contacts.

2.2.4 Control Cabinet

a. The breaker control cabinet shall be NEMA ICS 6, type 4X including hinged doors for full opening with provisions for holding doors in the open position and a handle with three point latch and padlocking provisions.

b. Current transformer leads shall be connected to short circuiting type terminal blocks located in the breaker control cabinet. The short circuiting strips of these blocks shall be grounded. All CT's leads shall be AWG #12.

c. The control cabinet shall be furnished with suitable strip heaters (240 VAC) for prevention of condensation.

2.2.5 Bushing Current Transformers

ANSI/IEEE C57.13. The circuit breaker shall be equipped with multi-ratio, bushing type current transformers, full ratio as indicated. ANSI accuracy class shall be relay class C400. Continuous-thermal-current rating factor shall be 2.0.

2.2.6 Miscellaneous Features

a. Paint ASTM D 1535 light grey No. 61. Paint coating system shall comply with ANSI C57.12.28.

b. Provide one set of special assembly and maintenance tools.

c. A circuit breaker nameplate mounted inside the breaker control cabinet with the following data.

(1) Manufacturer's name and address.

(2) Breaker type and model number.

(3) Breaker serial number.

(4) Rated nominal and maximum voltages.

(5) Rated voltage factor K.

(6) Rated continuous amps.

(7) Rated symmetrical interrupting capacity at maximum rated voltage.

(8) Rated frequency.

(9) Rated BIL.

(10) Operating ranges of control circuit voltages.

(11) Date of manufacture.

2.3 HIGH-VOLTAGE AIR INTERRUPTER SWITCHES

ANSI/IEEE C37.32. Provide station type, outdoor, three pole gang operated, station class, vertical break integer style, pedestal mounted, manually operated disconnect switches. The interrupter switch shall meet the preferred ratings listed in ANSI C37.06 and the following electrical characteristics:

Maximum Voltage, kV	38
Lightning Impulse, kV peak	200
Continuous Current, A	1200
Short-Time (3S) Withstand (symmetrical), kA	25
Peak Withstand, kA	40
Fault-Making Current, KA	30
Load Switching Current, A	1200

2.3.1 Rated Ice-Breaking Ability

The maximum thickness of ice deposited on the switch that will not interfere with the successful opening or closing of the switch shall be 9.525 mm.

2.3.2 Rated Mechanical Operations

The mechanical operation rating shall be in accordance with the ANSI/IEEE C37.32 preferred ratings.

2.3.3 Rated Mechanical Terminal Load

The rated mechanical terminal load shall be in accordance with the ANSI/IEEE C37.32 preferred ratings.

2.3.4 Nameplate Markings

Provide nameplates with markings in accordance with ANSI/IEEE C37.32.

2.4 HIGH-VOLTAGE AIR DISCONNECT SWITCHES

ANSI/IEEE C37.32. Provide station type, outdoor, three-pole, gang operated, station class, vertical break integer style, pedestal mounted, manually operated disconnect switches. The disconnect switch shall meet the preferred ratings listed in ANSI C37.06 and the following electrical characteristics:

Maximum Voltage, kV	38
Lightning Impulse, kV peak	200
Continuous Current, A	2000
Short-Time (3S) Withstand (symmetrical), kA	38
Peak Withstand, kA	70

2.4.1 Rated Ice-Breaking Ability

The maximum thickness of ice deposited on the switch that will not interfere with the successful opening or closing of the switch shall be 9.525 mm.

2.4.2 Rated Mechanical Operations

The mechanical operation rating shall be in accordance with the ANSI/IEEE C37.32 preferred ratings.

2.4.3 Rated Mechanical Terminal Load

The rated mechanical terminal load shall be in accordance with the ANSI/IEEE C37.32 preferred ratings.

2.4.4 Nameplate Markings

Provide nameplates with markings in accordance with ANSI/IEEE C37.32.

2.5 MEDIUM VOLTAGE CABLE TERMINATIONS

Provide as specified in Section 16303, "Underground and Underpier Electrical Work".

2.6 SURGE ARRESTERS

ANSI/IEEE C62.11. Provide porcelain housed, intermediate class, metal top arresters. Arrester insulation ratings shall be as follows:

Arrester Rating, kV rms	27
Minimum 1.2/50 microseconds Impulse Withstand, kV Crest	200
Minimum 1 minute Power-Frequency Dry Withstand, kV rms	95
Minimum 10 second Power-Frequency wet withstand, kV rms	80

2.7 34.5 KV OUTDOOR BUS

Shall be aluminum alloy 6063-T6 conforming to ASTM B 241. Buses shall be tubular, three phase and capable of carrying continuously ampere rating as indicated. Ampacity shall be based on 53 percent conductivity, a 30 degree centigrade temperature rise and an ambient temperature of 40 degrees centigrade.

2.8 POWER FUSES AND FUSE DISCONNECTING SWITCHES

ANSI C37.46. Provide station type, outdoor, single-pole, vertical 180 degree opening style fuse disconnecting switches with drop-out type power fuses. The fuse unit ampere rating shall be 1 ampere standard speed. The ratings of fuse disconnect switch and power fuse assembly shall be as follows:

Maximum Voltage, kV	38
Lightning Impulse, kV peak	200

Sym. Interrupting Current, A	17,500

2.9 POTENTIAL TRANSFORMERS

ANSI/IEEE C57.13. Provide outdoor, dry-type, two bushing, 300:1 ratio transformers rated 34,500 primary voltage, 200 kV BIL. Thermal rating shall be 55 degree C rise above 30 degree C ambient at 3000 VA. ANSI accuracy class at 60 hertz shall be 0.3.

2.9 STATION SERVICE TRANSFORMER (OVERHEAD-TYPE DISTRIBUTION)

a. ANSI C57.12.20.

b. Single phase, self-cooled, 65 degrees C. Continuous temperature rise, two winding, 60 Hertz.

c. Insulating liquid:

(1) Mineral oil per ASTM D 3487, Type II, tested in accordance with ASTM D 117.

(2) Provide identification of transformer as "non-PCB" on the nameplate.

(3) Do not provide insulating liquids containing polychlorinated biphenyls (PCB) or tetrachloroethylene (TCE) or perchloroethylene.

d. Ratings:

(1) kVA: 25.

(2) BIL: 200 kV.

(3) Primary voltage: 34.5 kV.

(4) Secondary voltage: 120/240 volts.

(5) Minimum Tested Impedance at 85 degrees C: 1.55 percent.

e. Single-phase connections:

(1) Connect primary: Phase-to-phase.

(2) Provide transformer with 2 high voltage bushing(s).

f. Taps:

(1) Provide four 2 1/2 percent full capacity taps, 2 above and 2 below rated primary voltage. Tap changer shall have external handle.

g. Corrosion Protection: Transformer tanks and covers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Paint coating system shall comply with ANSI C57.12.28 regardless of tank and cover material. Finish coat shall be light gray, ANSI color No. 70.

h. Show transformer kVA capacity using 65 mm Arabic numerals placed near the low-voltage bushings.

2.10.1 Specified Transformer Losses

No-load losses (NLL) in watts at 20 degrees C, and load losses (LL) in watts at 85 degrees C, shall be as follows:

NAME	KVA	"NLL"	"LL"
Service Station	25	69	281

The value for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values exceed the specified values by more than the tolerances allowed by Table 19 in IEEE C57.12.00, the transformer is unacceptable.

2.11 Relay and Metering Controlboard

Provide free-standing panel assembly complete with devices as indicated. Fabricate front, sides, back, and top of panel of 14-gage sheet steel in compliance with NEMA ICS 6, Type 12 enclosures. Provide front and back panel with hinged doors fabricated of 11-gage sheet steel. Provide devices mounted on the panel with nameplates of laminated black gloss-finished plastic with white engraved lettering.

2.11.1 Protective Relays

ANSI/IEEE C37.90 for dielectric strength and ANSI/IEEE C37.90.1 for surge withstand capability. Provide programmable, microprocessor-based relays enclosed in switchboard-type draw out cases. The relays shall provide the equivalent of three single-phase time overcurrent relays with selectable time overcurrent curves. The relays shall include the following protective functions and alarms, control, monitoring and metering, and user interface features:

2.11.1.1 Protective Functions and Alarms

The relays shall have the following ANSI/IEEE C37.2 device number ( ) functions.

a. Multi-function Protective Relay (MPR) shall include phase time (51) and instantaneous (50) overcurrent protection, ground time (51N) and instantaneous (50N) overcurrent protection, phase (67) and ground (67N) directional overcurrent protection, underfrequency (81U) protection, undervoltage (27) and overvoltage (59) alarm, and negative sequence voltage (47) alarm.

b. Multiphase Overcurrent Relay (MOR) shall include phase time (51) and instantaneous (50) overcurrent protection, and ground time (51N) and instantaneous (50N) overcurrent protection.

2.11.1.2 Control

The relays shall have contact outputs for breaker trip, breaker close, and breaker trip alarm, and contact inputs for breaker "a" and "b" auxiliary contacts.

2.11.1.3 Monitoring Metering

The relay shall have the following monitoring and metering features.

a. Metering for voltages, amperes, frequency, watts, watthours, vars, varhours, voltamperes, and power factor.

b. Peak demand for amperes, watts, and vars.

c. Record capture of the most recent faults, recording the time, date, cause, system parameters.

d. Waveform capture of the AC input voltage and currents triggered by the operation of a trip or logic input. The storage capacity shall be 128 cycles.

2.11.1.4 User Interface

The relays shall have the following user interface:

a. Keypad and display for viewing of metering values, demand values, setpoints, and fault records,and for programming of the relay without a computer.

b. Front RS-232 communication port.

c. Rear RS-485 (isolated) Modbus communication port.

2.11.2 Lockout Relays - IEEE Device 86

Provide hand reset, 125 VDC, electrically tripped, high-speed auxiliary relays. Relays shall be tripped by the indicated devices and shall be wired to trip the associated circuit breaker and prohibit closing of the circuit breaker by local and remote controls until the lockout relay has been reset by hand to its normal position.

2.11.3 Control Switches

Rotary cam-operated switches having positive means of indicating contact positions. Switches shall have silver-to-silver contacts enclosed in protective cover which can be removed to inspect the contacts, identifying escutcheon plates, and handle targets to indicate switch position. Provide standard pistol grip handles. Switches shall have a UL continuous rating of 30A-60VAC.

a. CS - Breaker Control Switch: Three position, spring return action, "TRIP" - "NORMAL AFTER TRIP/NORMAL AFTER CLOSE"-"CLOSE".

b. 43 - Selector Switch: Two position, maintained action, "REMOTE"-"LOCAL".

2.11.4 Indicating Lights

Provide LED type, push to test, semiflush, one hole mounting, oiltight, color as specified.

a. Breaker Closed Lights - red

b. Breaker Open Lights - green

2.11.5 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal blocks shall be readily accessible for making external connections as required. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.11.6 Wire Making

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70 and to the requirement specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and ANSI C2.

3.2.1 Connections

Provide compression connectors at equipment ends of ground conductors. Compression connectors shall be installed as specified in Section 16303, "Underground and Underpier Electrical Work."

3.2.2 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect high-voltage circuit breakers, air disconnect switches, and accessories furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 High-Voltage Air Interrupter and Disconnect Switches

ANSI/IEEE C37.35 as applicable.

3.3.2 Meters and Instrument Transformers

ANSI C12.1.

3.4 FIELD QUALITY CONTROL

3.4.1 Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 High-Voltage Circuit Breakers - Vacuum

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawing.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Inspect anchorage and grounding.

(5) Perform all mechanical operational tests on both the circuit breaker and its operating mechanism.

(6) Measure critical distances such a contact gap as recommended by manufacturer.

(7) Verify tightness of accessible bolted connections.

(8) Record as-found and as-left counter operations.

b. Electrical Tests

(1) Perform a contact-resistance test.

(2) Perform breaker travel and velocity analysis.

(3) Perform minimum pick-up voltage test on trip and close coils.

(4) Verify trip, close, trip-free, and antipump functions.

(5) Trip circuit breaker by operation of each protective device.

(6) Perform insulation-resistance tests pole-to-pole, pole-to-ground, and across open poles.

(7) Perform vacuum bottle integrity overpotential test across each vacuum bottle with the breaker in the open position.

(8) Perform insulation-resistance test on all control wiring.

(9) Perform dissipation-factor/power-factor tests on each pole with the breaker open and each phase with the breaker closed.

(10) Perform dissipation-factor/power-factor tests on each bushing.

(11) Perform overpotential test.

3.4.1.2 High-Voltage Air Switches

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Verify that grounding is in accordance with industry standards and contract documents.

(5) Verify tightness of accessible bolted electrical connections.

(6) Perform mechanical operator tests.

(7) Verify correct blade alignment penetration, travel stops, arc interrupter operation, and mechanical operation.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform overpotential test.

(3) Perform contact-resistance tests.

3.4.1.3 Instrument Transformers (Potential and Current)

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection of transformers with system requirements.

(4) Verify that adequate clearances exist between primary and secondary circuit wiring.

(5) Verify tightness of accessible bolted electrical connections.

(6) Verify that all required grounding and shorting connections provide contact.

(7) Verify correct primary and secondary fuse sizes for potential transformers.

b. Electrical Tests - Current Transformers

(1) Perform insulation-resistance tests.

(2) Perform polarity test.

(3) Perform a ratio-verification test.

(4) Perform an excitation test.

(5) Measure current circuit burdens at transformer terminals and determine the total burden.

(6) Perform insulation-resistance and dielectric withstand tests on the primary winding with secondary grounded.

c. Electrical Tests - Voltage Transformers

(1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground.

(2) Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationships as applicable.

(3) Perform a turns ratio test on all tap positions, if applicable.

(4) Measure potential circuit burdens at transformer terminals and determine the total burden.

(5) Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground.

3.4.1.4 Transformers (Overhead-type distribution)

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(4) Perform specific inspections and mechanical tests as recommended by manufacturer.

(5) Verify correct equipment grounding.

(6) Test load-tap changer, if applicable.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform continuity test.

(3) Set tap changer to provide a secondary voltage of 120/240.

3.4.1.5 Surge Arresters

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect for correct mounting and adequate clearances.

(4) Verify tightness of accessible bolted electrical connections. Perform thermographic survey.

(5) Verify that the ground lead on each device is individually attached to a ground bus.

b. Electrical Tests

(1) Test grounding connection.

(2) Perform a watts-loss test.

(3) Perform an insulation-resistance test.

3.4.1.6 Outdoor Bus

a. Visual and Mechanical Inspection

(1) Compare bus arrangement with drawings and specifications.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of accessible bolted electrical connections. Perform thermographic survey.

b. Electrical Tests

(1) Measure insulation resistance of each bus, phase-to-ground with other phases grounded.

(2) Perform overpotential test on each bus phase, phase-to-ground with other phases grounded.

(3) Measure resistance of bus section joints with low-resistance ohmmeter.

3.4.1.7 Protective Relays

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect relays and cases for physical damage.

(3) Tighten case connections. Inspect cover for correct gasket seal. Clean cover glass. Inspect shorting hardware, connection paddles, and/or knife switches. Verify target reset.

(4) Set relays in accordance with government provided settings.

b. Electrical Tests

(1) Perform insulation-resistance test on each circuit-to-frame.

(2) Inspect targets and indicators.

c. Functional Operation - 27 Undervoltage Relay

(1) Determine dropout voltage.

(2) Determine time delay.

(3) Determine the time delay at a second point on the timing curve for inverse time relays.

d. Functional Operation - 47 Phase Sequence or Phase Balance Voltage Relay

(1) Determine positive sequence voltage to close the normally open contact.

(2) Determine positive sequence voltage to open the normally closed contact (undervoltage trip).

(3) Verify negative sequence trip.

(4) Determine time delay to close the normally open contact with sudden application of 120 percent of pickup.

(5) Determine time delay to close the normally closed contact upon removal of voltage when previously set to rated system voltage.

e. Functional Operation - 50 Instantaneous Overcurrent Relay

(1) Determine pickup.

(2) Determine dropout.

(3) Determine time delay.

f. Functional Operation - Time Overcurrent

(1) Determine minimum pickup.

(2) Determine time delays at two points on the time current curve.

g. Functional Operation - 59 Overvoltage Relay

(1) Determine overvoltage pickup.

(2) Determine time delay to close the contact with sudden application of 120 percent pickup.

h. Functional Operation - 67 Directional Overcurrent Relay

(1) Determine directional unit minimum pickup at maximum torque angle.

(2) Determine closing zone.

(3) Determine overcurrent unit pickup.

(4) Determine overcurrent unit time delay at two points on the time current curve.

i. Functional Operation - 81 Frequency Relay

(1) Verify frequency set points.

(2) Determine time delay.

(3) Determine undervoltage cutoff.

j. Functional Operation - 87 Differential (Existing)

(1) Determine operating unit pickup.

(2) Determine the operation of each restraint unit.

(3) Determine slope.

(4) Determine harmonic restraint.

(5) Determine instantaneous pickup.

k. Control Verification

Verify that each of the relay contacts performs its intended function in the control scheme including breaker trip tests, close inhibit tests, 86 lockout tests, and alarm monitoring functions.

-- End of Section --

****
NOTE: THIS SPECIFICATION SECTION CONTAINS PROPRIETARY REQUIREMENTS
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SECTION 16360

SECONDARY UNIT SUBSTATIONS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M013	(1983) Detailing for Steel Construction
AISC M016	(1989) ASD Manual of Steel Construction
AISC M017	(1992; Errata 1994) Connections

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C37.121	(1989; R 1995) Switchgear - Unit Substations - Requirements
ANSI C57.12.13	(1982) Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1994) Carbon Structural Steel
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 117	(1996) Electrical Insulating Oils of Petroleum Origin
ASTM D 149	(1993; Rev. A) Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

ASTM D 1535	(1996) Specifying Color by the Munsell System
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

ANSI/IEEE 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
ANSI/IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
ANSI/IEEE C37.90	(1989) Relays and Relay Systems Associated with Electric Power Apparatus
ANSI/IEEE C37.90.1	(1989) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C57.12.00	(1993) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI/IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers
ANSI/IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
ANSI/IEEE C57.13	(1993) Instrument Transformers
ANSI/IEEE C57.96	(1989) Loading Dry-Type Distribution and Power Transformers
ANSI/IEEE C57.98	(1993) Guide for Transformer Impulse Tests
ANSI/IEEE C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits

MILITARY SPECIFICATIONS (MIL)

MIL-PRF-85285	(Rev. C) Coating: Polyurethane, High-Solids
MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1995) Electrical Power Distribution

	Equipment and Systems
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LI 1	(1989) Industrial Laminated Thermosetting Products
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1996; Errata #1) National Electrical Code
NFPA 70B	(1994) Electrical Equipment Maintenance
STEEL STRUCTURES PAINTING COUNCIL (SSPC)	
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC PA 1	(1991) Paint Application Specification No. 1, Shop, Field, and Maintenance Painting
UNDERWRITERS LABORATORIES INC. (UL)	
UL 50	(1995; R 1997) Enclosures for Electrical Equipment
UL 67	(1993; R 1995) Panelboards
UL 83	(1996; Bul. 1997, R 1998) Thermoplastic-Insulated Wires and Cables
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment
UL 489	(1991; Bul. 1992, 1993, 1994, and 1996, R 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 869	(1989; R 1991, Bul. 1992 and 1995) Service Equipment
UL 1778	(1997) Uninterruptible Power Supply Equipment

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" and Section 16081, "Apparatus Inspection and Testing" apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures".

1.4.1 SD-01, Data

a. Transformer Losses G

b. Assembled Operation and Maintenance Manuals G

1.4.1.1 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses".

1.4.2 SD-02, Manufacturer's Catalog Data

a. Separable Insulated High-Voltage Connectors G

b. Surge Arresters G

c. Grounding Elbows G

d. Connector Protective Caps G

e. Transformer Accessories G

f. Switchgear G

g. Power Receptacles G

h. Current Transformers G

i. Panelboards G

j. Station Battery G

k. Station Battery Charger G

l. Push Buttons G

m. Control Receptacles G

1.4.3 SD-04, Drawings

a. Transformer Drawings G

b. Switchgear and Power Outlet Assembly G

c. Skid Base Fabrication Drawings G

1.4.3.1 Transformer Drawings

Drawing shall include the following:

a. General arrangement (outline) drawing with front, plan, and side views of transformer and incoming section.

b. ANSI nameplate data (both the transformer unit and the transformer coil insulation BIL ratings shall be indicated).

c. Schematic/Elementary diagrams.

d. Connection/Wiring diagrams.

e. Bill of materials.

1.4.3.2 Switchgear and Power Outlet Assembly

Drawings shall include the following:

a. One-line diagram.

b. Three-line diagram.

c. Outline drawings including front elevation, section views, plan view, dimensions of equipment and locations of devices on equipment.

d. Bus arrangements including dimensions and ampere ratings of all bus bars.

e. Schematic/Elementary diagrams.

f. Connection/Wiring diagrams.

g. Bill of materials.

h. Manufacturer's published time curves (on full size 279 mm by 431 mm logarithmic transparency paper) for electrical protective devices.

1.4.3.3 Skid Base Fabrication Drawings

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC M013, AISC M016 and AISC M017. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols.

1.4.4 SD-08 Statements

a. Year 2000 (Y2K) Compliance Warranty G

1.4.4.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.5 SD-11, Factory Test Reports

a. Transformer design tests G

b. Transformer acceptance tests G

c. Transformer routine and other tests G

d. Switchgear design and production tests G

1.4.6 SD-13, Certificates

a. Coating system G

1.4.6.1 Coating System

Certify conformance to contract requirements and provide copies of test results of a representative batch as required by each individual product specification.

1.4.7 SD-18, Records

a. Equipment test schedule G

1.4.8 SD-19, Operation and Maintenance Manuals

a. Separable Insulated High-Voltage Connectors, Data Package 2 G

b. Surge Arresters, Data Package 2 G

c. Grounding Elbows, Data Package 2 G

d. Transformer, Data Package 4 G

e. Switchgear, Data Package 4 G

Submit Operation and Maintenance Manuals in accordance with Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems, solid state devices and controls, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 SECONDARY UNIT SUBSTATION

Unit substation dimensions shall be as indicated. Secondary unit substations shall comply with ANSI C37.121 regardless of the kVA rating specified. Substation shall consist of one incoming section, one transformer section, one secondary transition section, one outgoing switchgear section, and a power outlet assembly. Substation shall be designed for outdoor service with ventilation openings and gasketing provided to ensure a weatherproof assembly under rain, snow, sleet, and hurricane conditions. External doors shall have provisions for padlocking.

2.2.1 Incoming Section

The incoming section shall be a full-height (dimension as indicated) air-filled terminal chamber for connecting the incoming circuit directly to the transformer via separable insulated high-voltage connectors. Chamber shall be bottom entry with bolt-on front panel and top cover. Incoming section shall be a NEMA ICS 6 type 3R enclosure fabricated of ASTM A 167 type 304 or 304L stainless steel. Paint ASTM D 1535 light grey No. 61. Paint coating system shall comply with ANSI C57.12.28.

2.2.1.1 Separable Insulated High-Voltage Connectors

ANSI/IEEE 386. Provide 35 kV, 150 kV BIL, 600 ampere deadbreak connectors with 200 ampere loadbreak interface. Short time rating: 27,000 amperes rms, symmetrical for a time duration of 4.0 seconds. Connectors and inserts shall be the product of a single manufacturer. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc quenching contact material.

2.2.1.2 Surge Arresters

ANSI/IEEE C62.11. Rated 27 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging onto the 600 ampere deadbreak connector 200 ampere loadbreak interface.

2.2.1.3 Grounding Elbows

ANSI/IEEE 386. Voltage rating 35 kV. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms, symmetrical for a time duration of 0.17 seconds. Each grounding elbow shall have a stainless steel pulling eye and a 600-volt insulated, stranded, copper ground cable. Provide one set of grounding elbows for each unit substation to be stored in the incoming section.

2.2.1.4 Connector Protective Caps

Provide one set of connector protective caps for each unit substation to be stored in the incoming section.

2.2.2 Transformer Section

ANSI C57.12.13. Oil-insulated transformer fabricated entirely of ASTM A 167 type 304 or 304L stainless steel.

2.2.2.1 Transformer Ratings

a. Cooling Class: Liquid-Immersed, Air-Cooled

b. Phases: Three-Phase

c. Rated Kilovoltamperes: 4000 kVA

d. Voltage Rating: 34.5 kV - 480Y/277V

e. Impedance: Minimum tested impedance shall not be less than 6.3 percent at 85 degrees C.

f. Insulation Level: 200 kV BIL

g. Temperature Rise: 65 degree C average winding temperature rise above a 30 degree C ambient.

h. Audible Sound Levels: Audible sound level shall be 64 decibels (db) maximum.

2.2.2.2 Specified Transformer Losses

No-load losses (NLL) shall be 3260 watts at 20 degrees C and load losses (LL) shall be 25650 watts at 85 degrees C. The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values differ from the specified values by more than the tolerances allowed by Table 19 in IEEE C57.12.00, the transformer is unacceptable.

2.2.2.3 Transformer Features

The transformer shall include the following features:

a. Height of high voltage bushings shall be 1778 millimeters above bottom of transformer base.

b. NEMA ICS 6, type 4X stainless steel control box.

c. Transformer base with provisions for jacking and for rolling in either direction

d. Lifting provisions

e. Bolted transformer top manhole access

f. Four 2.5 percent full capacity taps, two above and two below rated primary voltage.

2.2.2.4 Transformer Accessories

The transformers shall include the following accessories:

a. Tap changer, with external, pad-lockable, manual type operating handle, for changing tap setting when the transformer is de-energized.

b. ANSI/IEEE 386, 35 kV, 150 kV BIL, 600 ampere one-piece deadbreak apparatus bushings.

c. Insulated low-voltage neutral bushing with lugs for ground cable and removable ground strap.

d. Stainless steel ground pads.

e. Liquid-level indicator.

f. Pressure-vacuum gage.

g. Liquid temperature indicator.

h. Drain and filter valves.

i. Pressure relief device, top mounted, qualitron series 208.

j. Sudden Pressure Relay.

k. Diagrammatic stainless steel or laser-etched anodized aluminum nameplate

2.2.2.5 Insulating Liquid

Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.2.3 Secondary Transition Section

The secondary transition section shall have a hinged front panel, a 5000 ampere, three-phase, four-wire main bus, removeable phase and neutral flex-braid bus links. Phase buses and connections and enclosure shall be in accordance with the paragraph entitled "Outgoing Switchgear Section."

2.2.4 Outgoing Switchgear Section

ANSI/IEEE C37.20.1 for metal-enclosed, low-voltage power circuit breaker type, insulated for 600 volts for use on a 480-volt system.

a. Enclosure: Shall be NEMA ICS 6 type 3R and designed in accordance with BOCA, fabricated entirely of ASTM A 167 type 304 or 304L stainless steel. Enclosure frame shall be bolt together, 12 gauge stainless steel. All interior and exterior covers and doors shall be minimum 12 gauge stainless steel sheets. Side and top covers shall be removable, front and rear covers shall be hinged and provided with stainless steel pad lockable vault handles with a three point catch. Roof shall be sloped toward rear. Paint enclosure ASTM D 1535 light grey No. 61. Paint coating system shall comply with ANSI C57.12.28.

b. Switchgear Compartments: Each unit forming part of the outgoing section structure shall be a self-contained stainless-steel housing having individual breaker or instrument compartment, and a full height center and rear compartment for the bare buses and outgoing cable connections. Equip individual circuit breaker compartments with primary and secondary contacts, rails, disconnecting mechanism parts, and a cell interlock to prevent moving the removable element into or out of the "connected" position while the circuit breaker is closed. Provide an individual stainless-steel door for each breaker compartment. Each door shall have a 100 square mm viewing window for visual inspection of the breaker "OPEN/CLOSED" target. Provide an engraved circuit designation plate on each circuit breaker compartment door.

c. Phase Buses and Connections: Provide a 5000 ampere, three phase, three wire bus mounted on insulated supports of high-impact, non-tracking, high-quality insulating material and brace to withstand the mechanical forces exerted during short-circuit conditions when connected directly to a source having maximum of 85,000 rms amperes symmetrical available. Bus bars shall be silver plated electrolytic copper of 98 percent conductivity based on 1000 amperes per square inch density minimum. Phase bus bars shall be insulated with an epoxy finish coating powder providing a minimum breakdown voltage of 16,000 volts per ASTM D 149. Make bus bar connections from main buses to the incoming circuit breaker studs. Equip outgoing circuit breaker studs with mechanical clamp type cable connectors for the size of cables shown.

d. Ground Bus: Provide a copper ground bus secured to each vertical structure and extending entire length of switchgear. Include provisions for making the station ground connections.

e. Insulated Barriers: Provide barriers in accordance with NEMA LI 1, Type GPO-3, 6.35 mm minimum thickness. Apply moisture resistant coating to all rough-cut edges.

f. Switchgear Cables: Provide extra flexible stranded copper conductor conforming to UL 83 and UL 1778, type MTW rated VW-1. Minimum cable ampacity shall be 600 amperes continuous at 90 degree C operating temperature based on single conductor, in free air, at 30 degrees C ambient air temperature.

2.2.4.1 Main Circuit Breaker

Provide 48VDC electrically operated stored energy fixed insulated case circuit breaker. Breaker ampere frame rating (AF) shall be as indicated. Interrupting rating shall not be less than 100,000 amperes symmetrical at 480 volts. Equip electrically operated breakers with motor-charged, stored energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operators strength or effort in closing the handle.

2.2.4.2 Secondary Feeder Breakers

Provide 120VAC electrically stored energy drawout type power air circuit breakers. Breaker ampere frame rating (AF) shall be as indicated. Secondary breakers shall be equipped with integral current-limiting fuses and shall have an interrupting rating not less than 200,000 amperes symmetrical at 480 volts. Circuit breaker shall trip if any one current-limiting fuse blows. Closing of circuit breaker shall be prevented until fuse has been replaced. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle.

(1) Contacts: Silver-plated, multifinger, positive pressure, self-aligning type for auxiliary, control, and main drawout contacts.

(2) Each drawout breaker shall be provided with four-position operation. Each position shall be clearly identified by an indicator on the circuit breaker front panel.

(a) Connected Position: Primary and secondary contacts are fully engaged. The breaker must be tripped before it can be racked into or out of this position.

(b) Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. Position shall allow complete test and operation of the breaker without energizing the primary circuit.

(c) Disconnected Position: Primary and secondary contacts are disconnected.

(d) Withdrawn (Removed) Position: Places breaker completely out of compartment, ready for removal.

2.2.4.3 Electronic Trip Assembly

NOTICE: PROVIDED ELECTRONIC TRIP ASSEMBLY MUST BE THE FOLLOWING PRODUCT; notwithstanding any other provisions of this solicitation, no product other than Cutler-Hammer type Westinghouse Digitrip RMS units, will be acceptable.

Equip each low-voltage power circuit breaker with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing circuit protection. The ampere rating of the current sensors shall be the same as the breaker frame rating. The trip unit ampere trip rating shall be as indicated. The electronic trip assembly shall have the following features:

a. Overcurrent protection to include longtime, short time and ground fault tripping settings for the main breakers; and long time, instantaneous, and ground fault trip settings for the feeder breakers.

b. Energy monitoring for peak demand, present demand, and energy consumption.

c. Metering for individual phase currents and ground current.

d. Metering for individual phase voltage (main breaker only).

e. Four-digit alphanumeric display for indication of the following data:

(1) Cause of circuit breaker trip

(2) Trip current

(3) Phase and ground current

(4) Phase voltage (main breaker only)

(5) Energy parameters

f. Provision for integral testing of all protective functions

g. Provisions for communication via a network twisted pair for remote monitoring and control.

2.2.4.4 Electronic System Monitor (ESM)

Provide a microprocessor based, door-mounted, electronic system monitor that communicates to remote devices via a network twisted pair. The electronic system monitor shall monitor and display parameters of the associated unit substation switchgear circuit breakers. The electronic system monitor shall have the following features:

a. Eight-digit alphanumeric display for indication of the following data for each circuit breaker:

(1) Cause of circuit breaker trip

(2) Phase and ground current

(3) Energy parameters

b. Indication for circuit breakers status; tripped, open, closed.

c. Provisions for communicating via a network twisted pair all monitored circuit breaker parameters to a remote personal computer.

2.2.4.5 Instrument Control Switches

Provide rotary cam-operated type with positive means of indicating contact positions. Switches shall have silver-to-silver contacts enclosed in a protective cover which can be removed to inspect the contacts. Provide standard pistol grip handles.

a. CS - Breaker Control Switch: Three position, spring return action, "TRIP" - "NORMAL AFTER TRIP/NORMAL AFTER CLOSE" - "CLOSE".

b. BS - Bypass Switch: Two position, maintained action, "NORMAL" - "BYPASS".

2.2.4.6 Drawout Relays

Relay shall conform to ANSI/IEEE C37.90 and ANSI/IEEE C37.90.1. Protective relays shall be solid-state type enclosed in rectangular, semiflush, switchboard-type drawout case with indicating targets and provisions for testing in the case by use of manufacturer's standard test blocks or test switches.

a. Bus Differential Relays, IEEE Device 87B: Provide single phase, high speed, high impedance, voltage operated relays that are designed to provide protection in bus differential schemes.

Provide a high speed instantaneous overcurrent unit in addition to the voltage operated unit.

b. Lockout Relays, IEEE Device 86: Provide hand reset, electrically tripped, high-speed auxiliary relays as indicated. Relays shall be tripped by the indicated devices and shall be wired to trip the as indicated circuit breakers and prohibit closing of the circuit breaker by local and remote controls until the lockout relay has been reset by hand to its normal position. Each relay shall be provided with the number of contacts as indicated.

c. Sudden Pressure Auxiliary Relay (Device 63X): Provide a multicontact, high-speed relay operating in one-half cycle or less, suitable for semi-flush mounting, in a drawout case. Relay shall have contacts rated to carry 30 amperes for one minute and 12 amperes continuously. Coils shall be a long-life design with a projected service life of 40 years.

2.2.4.7 Control Power Transformers

Transformer shall be sized as required to serve the connected load and shall have a primary voltage rating of 480 volts single-phase, and 120/240 volts secondary, 60 Hz. Transformer shall be dry-type, two-winding type, 115 degrees C rise above 40 degrees C maximum ambient designed for mounting in switchgear cubicle or drawer. Transformer shall be designed for continuous operation 24 hours a day, 365 days a year with normal life expectancy as defined in ANSI/IEEE C57.96.

2.2.4.8 Molded Case Circuit Breakers

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated.

2.2.4.9 Heaters

Provide 120-volt stainless-steel heaters in each switchgear section. Heaters shall be of sufficient capacity to control moisture condensation in the compartments, shall be 250 watts minimum, and shall be controlled by a thermostat and humidistat located in each section. Thermostat shall be industrial type, high limit, to maintain compartments within the range of 15.5 to 32.2 degrees C. Humidistat shall have a range of 30 to 60 percent relative humidity.

2.2.5 Power Receptacles

Rated for 600 volts, 500 amperes, 60 hertz, single-pole, continuous duty operation. Receptacles shall be compatible with Duraline standard latching ball nose male plugs. Receptacle shall be angled 15 degrees and be designed for mounting on a vertical plate and connecting a lugged cable via a threaded stud and a hex jam nut. The receptacle shall have a thru-center plunger which activates a two circuit single-pole double-throw, water tight aluminum housed switch. The switch shall be electrically rated for 25,000 cycles at 450 volts, 2 amperes, 60 hertz, and shall be mechanical rated for 20,000,000 cycles. Receptacles shall be provided with protective cap attached via wirelon and shall be color coded red phase A, black phase B, and white phase C.

2.2.6 Panelboards

UL 869, UL 67, and UL 50 having a short-circuit current rating as indicated. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Directories shall also indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Switchgear CPT). Type directories and mount in holder behind transparent protective covering.

a. Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

b. Circuit Breakers shall be UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker is mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.2.7 Station Battery

Provide 24 VDC, maintenance free, sealed, lead-acid, totally absorbed electrotype, suitable for the DC control power requirements of the switchgear operating in an ambient temperature of 0 degrees C.

2.2.8 Station Battery Charger

Provide 120 volts ac, 60 Hz, enclosed, automatic equalizing, dual-rate solid-state, constant voltage type battery charger with automatic AC line compensation. DC output shall be voltage regulated and current limited. Charger shall have two ranges, float and equalize, and shall provide continuous taper charging and automatic battery temperature compensation. The charger shall have a continuous output rating of not less than 10 amperes and shall be sized to recharge the station batteries in a minimum of eight hours while providing all the control power needs of the switchgear. Enclosure shall be NEMA ICS 6 type 1. The following accessories shall be included:

a. DC ammeter

b. DC voltmeter

c. Equalize light

d. AC on light

e. Low voltage light

f. High voltage light

g. Equalize test button/switch

h. AC circuit breaker

i. Low DC voltage alarm relay

j. High DC voltage alarm relay

k. Current failure relay

l. AC power failure relay

2.2.9 Current Transformers

ANSI/IEEE C57.13. Transformers shall be single ratio, 60 hertz, 600-volts insulation, 10 KV BIL, window type. Size current transformers as indicated. Continuous - thermal - current rating factor (RF) and ANSI Relay Accuracy Class shall be in accordance with the following tables:

RATIO	Accuracy Class	RF at 30 degrees C
5000/5	C200	1.33

2.2.10 Pushbuttons

Provide one NEMA Q600 rated, 30 millimeter, heavy duty industrial type, normally-open, momentary red pushbutton, housed in a flush mounted NEMA 4X device box with a spring cover.

2.2.11 Control Receptacles

Receptacles shall be housed in a NEMA 4X device box with a spring door cover. Provide connecting plug for each receptacle.

2.2.11.1 MIL-C-5015 Receptacles

MIL-C-5015 Receptacles shall be box mounting, socket type with 27 no. 12 contacts.

2.2.11.2 NEMA Receptacles

NEMA receptacles shall be two-pole, three-wire, 20 ampere, 250 volt, NEMA L6 - 20R configuration.

2.2.12 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal blocks shall be readily accessible for making external connections as required. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.2.13 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.2.14 Skid Base

Provide the secondary unit substation on a portable, AWS D1.1 all welded structural steel skid base, constructed entirely of ASTM A 36/A 36M steel and ASTM A 53 pipe. Structural steel skid base including design, materials, installation, workmanship, fabrication, assembly, erection inspection, quality control, and testing shall be provided in accordance with AISC M016 and AISC M017 except as modified in this contract. The structural skid shall be designed to safely support the weight of the complete skid mounted substation. Twelve gage stainless-steel plates shall cover entire top of skid base except under unit-substation. The entire structural skid and portable substation shall be designed to be lifted without the aid of a lifting frame. All welds shall be 100% visually inspected. All full penetration welds shall be 100% radiographically inspected and 30% of all other welds shall be magnetic particle tested. The entire skid shall be blasted clean to SSPC SP 10 requirements (near white), then painted with with the following system in accordance with SSPC PA 1: Epoxy Polyamide Zinc Rich Primer MIL-P-24441/19, Formula 159, white (tinted), 3.0 mils DFT; Epoxy Polyamide intermediate coat, MIL-P-24441/31, Formula 152, type IV, white (tinted), 3.0 mils DFT; and topcoat, MIL-PRF-85285, type II, 2.0 mils DFT.

2.3 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.4 WARNING SIGNS

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.5 ASSEMBLED OPERATION AND MAINTENANCE MANUALS

Manuals shall be in separate books or volumes, assembled and bound securely in durable, hard covered, water resistant binder, and indexed by major assembly and components in sequential order. A table of contents shall be made part of the assembled O&M manuals. The manual shall be assembled in the order noted in table of contents. The cover sheet or binder on each volume of the manuals shall be identified and marked with the words, "Operation and Maintenance Manual." The contents of the assembled operation and maintenance manuals shall be as follows:

a. Manufacturer's O&M information required by the paragraph entitled, "SD-19, Operation and Maintenance Manuals."

b. Catalog data required in the paragraph entitled, "SD-02, Manufacturer's Catalog Data."

c. Drawings required in the paragraph entitled, "SD-04, Drawings".

d. Recommended spare parts list. The recommendation for spare parts shall consider quantity of identical parts, application, availability of replacement parts and location of the project. Recommended spare parts list for each piece of equipment shall be certified by the equipment manufacturer.

e. Transformer design test required in the paragraph entitled "SD-11, Factory Test Reports".

f. Transformer routine tests required in the paragraph entitled "SD-11, Factory Test Reports".

2.6 SOURCE QUALITY CONTROL

2.6.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Transformer Design Tests

In accordance with IEEE C57.12.00 and ANSI/IEEE C57.12.90. Additionally, ANSI/IEEE C57.12.80 section 5.1.2 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer(s). Design tests shall have been performed prior to the award of this contract.

Transformers manufactured by ABB in South Boston, VA; by Cooper Power Systems in Waukesha, WI; or by Howard Industries in Laurel, MS need not meet this submittal requirement. Note: The factory test as specified in the paragraph entitled, "Transformer Acceptance Test", is required by all manufacturers.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a unit-substation transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (OA), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

(1) ANSI/IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and ANSI/IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a transformer in the same weight range as the transformer specified.

e. Pressure: "Basically the same design" for the pressure test means a unit-substation transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.6.3 Transformer Acceptance Tests

In accordance with IEEE C57.12.00 and ANSI/IEEE C57.12.90 and as specified herein. Submit test reports, by serial number (complete with test data, explanations, formulas, and results) showing the results of design tests performed on one of the specified transformers.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: If only one winding is used for the Temperature Rise Test, the center winding (generally B Phase) shall be used. The average temperature of a winding shall be determined by the resistance method - no other method will be accepted.

c. Lightning impulse: Design lightning impulse tests shall include both the primary and secondary windings of that transformer. Conduct 200 kV BIL impulse test with the primary windings isolated from the high voltage bushings. Conduct 150 kV BIL test with the primary windings connected to the high voltage bushings.

(1) ANSI/IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and ANSI/IEEE C57.98

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

(4) Provide pressure tests

2.6.4 Transformer Routine and Other Tests

In accordance with IEEE C57.12.00 and ANSI/IEEE C57.12.90. Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. Insulation power-factor by manufacturer's test method.

e. No-load losses (NLL) and excitation current

f. Load losses (LL) and impedance voltage

g. Dielectric

(1) Impulse: Per ANSI/IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and ANSI/IEEE C57.98. Test the primary winding only.

(a) State test voltage levels

(b) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports. As an alternative, photographs of oscilloscope display waveforms or plots of digitized waveforms may be hand-delivered at the factory witness test.

(2) Applied voltage

(3) Induced voltage

h. Leak

2.6.5 Switchgear Design and Production Tests

In accordance with ANSI/IEEE C37.20.1. Furnish documentation showing the results of design tests on a product of identical construction and rating as that provided by this specification. Furnish reports which include results of production tests performed on the actual equipment for this project. Required tests shall be as follows:

a. Design Test

    (1) Dielectric test

    (2) Rated continuous current test

    (3) Short-time current withstand tests

    (4) Short-circuit current withstand tests

    (5) Mechanical endurance tests

    (6) Flame-resistance tests

    (7) Rod entry tests

    (8) Paint qualification test

b. Production Test

    (1) Dielectric test

    (2) Mechanical operation tests

    (3) Grounding of instrument transformer case test

    (4) Electrical operation and control-wiring tests

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall comply with NFPA 70.

3.2 GROUNDING

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect unit substations furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Instrument Transformers

ANSI C12.1.

3.3.2 Low-Voltage Switchgear

ANSI/IEEE C37.20.1.

3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Transformers (Liquid-Filled)

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Verify that cooling fans and pumps operate correctly and that fan and pump motors have correct overcurrent protection.

(4) Verify operation of all alarm, control, and trip circuits from temperature and level indicators, pressure relief device and fault pressure relay.

(5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(6) Verify correct liquid level in transformer tank.

(7) Perform specific inspections and mechanical tests as recommended by manufacturer.

(8) Verify correct equipment grounding.

(9) Test load tap-changer, if applicable.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform turns-ratio tests.

(3) Perform insulation power-factor/dissipation-factor tests on windings.

(4) Sample insulating liquid. Sample shall be tested for:

(a) Dielectric breakdown voltage

(b) Acid neutralization number

(c) Specific gravity

(d) Interfacial tension

(e) Color

(f) Visual Condition

(g) Parts per million water

(h) Dissipation factor or power factor.

(5) Remove a sample of insulating liquid and perform dissolved gas analysis (DGA).

(6) Test for presence of PCB.

(7) Verify that the tap-changer is set at specified ratio.

(8) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.4.1.2 Switchgear Assemblies

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical, electrical, and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Verify appropriate anchorage, required area clearances, and correct alignment.

(5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

(6) Verify that fuse and circuit breaker sizes and types correspond to approved shop drawings.

(7) Verify that current transformer ratios correspond to approved shop drawings.

(8) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(10) Clean switchgear

(11) Inspect insulators for evidence of physical damage or contaminated surfaces.

(12) Verify correct barrier and shutter installation and operation.

(13) Exercise all active components.

(14) Inspect all mechanical indicating devices for correct operation.

(15) Verify that filters are in place and/or vents are clear.

(16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects, current-carrying and grounding.

(17) Inspect control power transformers.

b. Electrical Tests

(1) Perform insulation-resistance tests on each bus section.

(2) Perform overpotential tests.

(3) Perform insulation-resistance test on control wiring.

(4) Perform control wiring performance test.

(5) Perform primary current injection tests on the entire current circuit in each section of assembly.

(6) Verify operation of switchgear/switchboard heaters.

3.4.1.3 Circuit Breakers - Low-Voltage, Power

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Inspect anchorage, alignment, and grounding. Inspect arc chutes. Inspect moving and stationary contacts for condition, wear, and alignment.

(5) Verify that all maintenance devices are available for servicing and operating the breaker.

(6) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

(7) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

(8) Verify tightness of accessible bolted bus connections by calibrated torque-wrench method.

(9) Check cell fit and element alignment.

(10) Check racking mechanism.

b. Electrical Tests

(1) Perform contact-resistance tests on each breaker.

(2) Perform insulation-resistance tests.

(3) Adjust Breaker(s) for final settings in accordance with Government provided settings.

(4) Determine pickup current by primary current injection.

(5) Determine long-time delay by primary current injection.

(6) Determine short-time pickup and delay by primary current injection.

(7) Determine ground-fault pickup and delay by primary current injection.

(8) Determine instantaneous pickup by primary current injection.

(9) Activate auxiliary protective devices, such as under-voltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.

(10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

(11) Check charging mechanism.

3.4.1.4 Circuit Breakers - Low-Voltage, Insulated-Case

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect circuit breaker for correct mounting.

(3) Operate circuit breaker to ensure smooth operation.

(4) Inspect case for cracks or other defects.

(5) Verify tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method.

(6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Adjust Breaker(s) for final settings in accordance with Government provided settings.

(4) Perform long-time delay time-current characteristics tests.

(5) Determine short-time pickup and delay by primary current injection.

(6) Determine ground-fault pickup and time delay by primary current injection.

(7) Determine instantaneous pickup current by primary injection.

(8) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.

3.4.1.5 Instrument Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection

(4) Verify that adequate clearances exist between primary and secondary circuit wiring.

(5) Verify tightness of all accessible bolted electrical connections.

(6) Verify that all required grounding and shorting connections provide contact.

(7) Verify correct operation of transformer withdrawal mechanism and grounding operation.

(8) Verify proper primary and secondary fuse sizes for potential transformers.

b. Electrical Tests - Current Transformers

(1) Perform insulation-resistance tests of the current transformers and wiring to-ground at 1000 Vdc.

(2) Perform polarity tests.

(3) Perform ratio-verification tests.

c. Electrical Tests - Voltage Transformers

(1) Perform insulation-resistance tests winding-to-winding and windings-to-ground.

(2) Perform a polarity tests on each transformer.

(3) Perform a turns ratio test on all tap positions as applicable.

3.4.1.6 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters to manufacturer's published data.

(3) Verify all instrument multipliers

(4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.4.1.7 Surge Arresters Devices

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specification and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect for correct mounting and adequate clearances.

(4) Verify tightness of accessible bolted electrical connections.

(5) Verify that the ground lead on each device is individually attached to a ground bus.

b. Electrical Tests

(1) Perform insulation-resistance tests.

3.4.1.8 Battery Systems

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with drawings and specifications.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data. Thermographic survey is not required.

(4) Measure electrolyte specific gravity and temperature and visually check fill level.

b. Electrical Tests

(1) Set charger float and equalizing voltage levels.

(2) Verify all charger functions and alarms.

(3) Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.

(4) Measure intercell connection resistances.

3.4.1.9 Protective Relays

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specification and approved shop drawings.

(2) Inspect relays and cases for physical damage. Remove shipping restraint material.

(3) Tighten case connections. Inspect cover for correct gasket seal. Clean cover glass. Inspect shorting hardware, connection paddles, and/or knife switches. Remove any foreign material from the case. Verify target reset.

(4) Set relays in accordance with government provided settings.

b. Electrical Tests

(1) Perform insulation-resistance test on each circuit-to-frame.

(2) Inspect targets and indicators

c. 63 - Transformer Sudden Pressure Relay Functional Operation

(1) Determine rate-of-rise or the pickup level of suddenly applied pressure in accordance with manufacturer's specifications.

(2) Verify operation of the 63 FPX seal-in circuit.

(3) Verify trip circuit to remote breaker.

d. 87 - Differential Relay Functional Operation

(1) Determine operating unit pickup

(2) Determine the operation of each restraint unit.

(3) Determine slope.

(4) Determine harmonic restraint.

(5) Determine instantaneous pickup.

e. Control Verification

Verify that each of the relay contacts performs its intended function in the control scheme including breaker trip tests, close inhibit tests, 86 lockout tests, and alarm functions.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days' advance notice of the dates and times for checks, settings, and tests.

-- End of Section --

SECTION 16403

ELECTRICAL DISTRIBUTION SYSTEM
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.7	(1993) Watthour Meter Sockets
ANSI C12.15	(1990) Electricity Metering Solid-State Demand Registers for Electromechanical Watthour Meters
ANSI C12.16	(1991) Electricity Metering Solid-State Electricity Meters
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity
ANSI C80.1	(1994) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1994) Electrical Metallic Tubing - Zinc Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 1535	(1996) Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

ANSI/IEEE C57.13	(1993) Instrument Transformers

MILITARY SPECIFICATION

MIL-C-915/6	(Rev. J) Cable, Power Electrical, 600 Volts, for Outboard Use Only (Not for Inboard Use), Type THOF
MIL-C-24368/1	(Rev. B) Connector Assemblies; Plug, Power Transfer, Shore to Ship and Ship to Ship,

	500 Volts, 500 Amperes, 60 Hertz, Symbol Number 1160
MIL-C-24368/2	(Rev. B) Connector Assemblies; Receptacle, and Receptacle - Cabled, Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Number 1161

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FG 1	(1993; Rev. 1994) Fiberglass Cable Tray Systems
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	(1993) Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA KS 1	(1996) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(1993; Rev. 1-4) Motors and Generators
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 14	(1984; R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
NEMA WD 1	(1983; R 1989) Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1	(1993; R 1995) Flexible Metal Conduit
UL 6	(1997) Rigid Metal Conduit
UL 50	(1995; R 1997) Enclosures for Electrical Equipment
UL 67	(1993; R 1995) Panelboards
UL 83	(1996; Bul. 1997, R 1998) Thermoplastic-Insulated Wires and Cables
UL 198E	(1988; R 1988, Bul. 1991, 1992, and 1993) Class R Fuses
UL 486A	(1997; R 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997) Splicing Wire Connectors
UL 489	(1991; Bul. 1992, 1993, 1994, and 1996, R 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	(1996; R 1998) Attachment Plugs and Receptacles
UL 506	(1994; R 1997, Bul. 1997) Specialty Transformers
UL 508	(1993; R 1997) Industrial Control Equipment
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; R 1998) Metallic Outlet Boxes
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 797	(1993; R 1997) Electrical Metallic Tubing
UL 869A	(1989; R 1991, Bul. 1992, 1993, and 1995) Service Equipment
UL 870	(1995) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	(1994; Bul. 1996, R 1997) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(1993; 1997) Ground-Fault Circuit-Interrupters
UL 984	(1996; Bul. 1996 and 1997) Hermetic Refrigerant Motor-Compressors

UL 1242	(1996; R 1998) Intermediate Metal Conduit

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 16001, "Division 16 Submittal Reduction Procedures ."

1.4.1 SD-02 Manufacturer's Catalog Data

a. Receptacles

b. Circuit breakers G

c. Switches G

d. Transformers G

e. Motor controllers G

f. Metering G

g. Cable Trays G

h. Single-Pole Power Receptacles G

i. Three-Pole Power Receptacles G

1.4.2 SD-04 Drawings

a. Panelboards G

b. Transformers G

c. Cable Tap Cabinets G

d. Remote Trip Pushbutton Panel G

e. Power Stations G

1.4.3 SD-08 Statements

a. Fuses G

b. Year 2000 (Y2K) Compliance Warranty G

1.4.3.1 Fuses

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.4.3.2 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.4 SD-11 Factory Test Reports

a. Transformer tests G

1.4.4.1 Transformer Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

1.4.5 SD-12 Field Test Reports

a. 600-volt wiring test G

b. Grounding system test G

c. Transformer tests G

1.4.6 SD-19 Operation and Maintenance Manuals

b. Metering, Data Package 5 G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data" and as specified herein.

1.5 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, HVAC controllers, utility monitoring and control systems, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.3 CONDUIT AND FITTINGS

Shall be rigid steel (zinc-coated) conduit, rigid nonmetallic conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT) and flexible metal conduit, conforming to the following:

2.3.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.3.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, in accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.3.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.3.4 Electrical Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.3.5 Flexible Metal Conduit

UL 1.

2.3.6 Fittings for Metal Conduit, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.3.6.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.3.6.2 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.3.7 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3.

2.3.8 Expansion Couplings for PVC Conduit

Expansion joints shall be watertight, weatherproof, and shall permit a relevant movement of up to 150 mm longitudinally. Couplings shall be designed for a temperature variation of 62 degrees C.

2.4 FIBERGLASS CONDUIT SUPPORTS

Provide as specified in Section 16303, "Underground and Underpier Electrical Work."

2.5 CABLE TRAYS

NEMA FG 1. Cable trays shall form a wireway system, and shall be of nominal 100 mm depth. Cable trays shall be constructed of fiberglass. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be as indicated.

2.5.1 Ladder-Type Cable Trays

Of nominal 760 mm width with maximum rung spacing of 305 mm.

2.6 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal.

2.7 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 1640 mL, UL 50, hot-dip, zinc-coated, if sheet steel.

2.8 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.8.1 Conductors Greater than 4/0

Provide conductors in sizes greater than 4/0 as specified in Section 16303, "Underground and Underpier Electrical Work".

2.8.2 Conductors 4/0 and Smaller

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No.

10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.8.2.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.8.2.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.8.3 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, 3-phase

    (1) Phase A - black

    (2) Phase B - red

    (3) Phase C - blue

b. 480/277 volt, 3-phase

    (1) Phase A - brown

    (2) Phase B - orange

    (3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.8.4 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83 , except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.8.5 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter;

ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.9 SPLICES AND TERMINATION COMPONENTS

UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.10 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.11 SWITCHES

2.11.1 Toggle Switches

NEMA WD 1, No. 1121 for single pole, No. 1122 for double pole, No. 1123 for three-way, and No. 1124 for four-way, totally enclosed with bodies of thermosetting plastic and mounting strap with grounding screw. Handles shall be brown. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated. Weatherproof switch shall be provided where indicated.

2.11.2 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6-watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green; jewels for other purposes shall be white.

2.11.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 3R enclosure, unless indicated otherwise, per NEMA ICS 6.

2.11.3.1 Manual Transfer Switch

Provide non-fusible double throw disconnect switch designed for manual transfer of loads from one supply to another. Switch shall be rated for service entrance equipment at 240 volts. Switch shall have 2 poles, be rated for 10 KAIC minimum, and have ampere rating indicated.

2.12 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of ivory thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.12.1 Duplex Receptacles

Duplex receptacles shall be 20 amperes, 125 volts, NEMA 5-20R.

2.12.2 Ground-Fault Circuit Interrupter (GFI) Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices.

2.13 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served form Panel MDP). Type directories and mount in holder behind transparent protective covering.

2.13.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.13.2 Main Protective Device

UL 489. Manually operated, 100 percent rated, with a minimum short-circuit-current rating equal to the short-circuit-current rating of the panelboard in which the circuit breaker will be mounted. Series rated circuit breakers are unacceptable. Breaker frame size and overcurrent protective device (rating plug) shall be as indicated. Breaker shall be equipped with solid-state trips, with current sensors and solid-state logic circuits integral to the circuit breaker frame. Current sensor rating shall be the same as the breaker frame rating. The solid-state current control shall provide adjustable ampere setting, adjustable long time delay, adjustable short time delay, and adjustable instantaneous trip. Settings shall be located behind cover to deter tampering.

2.13.3 Branch Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.13.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open.

2.13.3.2 Shunt Trip Breakers

Shunt trip breaker shall trip the circuit breaker from a remote location. Shunt trip shall be equipped with a red flag indicator. A coil clearing contact shall open the shunt trip coil circuit when the circuit breaker opens. In addition, multipole shunt trip breakers shall conform to requirements of paragraph entitled "Multipole Breakers".

2.14 MOTOR CIRCUIT PROTECTORS (MCP)

Motor circuit protectors; NEMA AB 1 and UL 489. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. MCPs shall be rated in accordance with NFPA 70.

2.15 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.15.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RK-5 time delay-type. Associated fuseholders shall be Class R only.

2.16 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, sealed. Provide transformers in NEMA 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

2.17 MOTORS

NEMA MG 1 ; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of kW, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.17.1 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.18 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.18.1 Control Circuits

Control circuits shall have a maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded. For designated systems, as indicated, provide backup power supply, including transformers connected to emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.18.2 Enclosures for Motor Controllers

NEMA ICS 6.

2.18.3 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.18.4 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.18.5 Terminal Blocks

NEMA ICS 4.

2.19 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, in accordance with Section 16721, "Telephone Distribution System".

2.20 CABLE TAP CABINETS

Provide a 600 ampere, three phase, three wire bus rated 600 volts for use on a 480 volt system. Bus shall withstand mechanical forces exerted during short-circuit conditions when connected directly to a source having maximum 25,000 rms amperes symmetrical available. Cabinets shall be designed for top and bottom entry/exit, unless indicated otherwise. Cabinets indicated to be bottom entry only shall be Type 4X, in conformance with NEMA ICS 6. Enclosures shall be 12 gauge stainless steel with removable front and rear covers. Paint enclosure light green No. 61 in accordance with ANSI C57.12.28 and ASTM D 1535.

2.21 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70, shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated.

2.22 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.23 WIREWAYS

UL 870. Material shall be steel galvanized 16 gage for size 100 by 100 mm, 14 gage for sizes 1016 by 610, 1800 by 890, 1016 by 610, and 305 by 305 mm. Provide in length indicated with screw-cover NEMA 3R enclosure per NEMA ICS 6. Boxes shall be nonmetallic where indicated.

2.24 METERING

Provide a self-contained, socket-mounted, electronic programmable outdoor watthour meter. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements and conform to ANSI C12.16.

a. Design: Provide watthour meter designed for use on a three-phase, 4-wire, 480Y/277 volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

b. Class: 20; Form: 9S, Accuracy: +/- 1.0. percent; Finish: Class II.

c. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

d. Kilowatt-hour Register: 5 digit electronic programmable type

e. Demand Register:

(1) Provide solid state ANSI C12.15.

(2) Meter reading multiplier: Indicate multiplier on the meter face.

(3) Demand interval length: Shall be programmed for 15 minutes with rolling demand up to six subintervals per interval.

f. Socket: ANSI C12.7. Provide NEMA Type 3R, box-mounted socket having manual circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Provide manufacturers standard enclosure color unless otherwise indicated.

g. Current Transformers: ANSI/IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kv BIL. Provide three current transformers with characteristics listed in the following table.

CT Ratio	RF	Meter Acc. Class
600/5	3.0	0.3 thru B-0.5

h. Meter Fusing: Provide a fuse block mounted in the enclosure containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

2.25 CABLE RACKS

Provide as specified in Section 16303, "Underground and Underpier Electrical Work".

2.26 POWER STATIONS

Power stations include enclosure, power receptacles, and related wiring.

2.26.1 Enclosure

Enclosure shall be NEMA ICS 6 fabricated of 12 gauge stainless steel. Paint ASTM D 1535 light grey No. 61. Paint coating system shall comply with ANSI C57.12.28.

2.26.2 Three-Pole Power Receptacles

Rated for 500 volts, 500 amperes, 60 hertz, three-pole, continuous duty operation. Power receptacle shall conform to MIL-C-24368/2. Provide receptacle assembly with factory potted cable pigtails. Cable pigtails shall be 3-1/c, type as specified in Section 16303, "Underground and Underpier Electrical Work", and shall be of suitable length to connect to its respective cable tap cabinet as indicated. Provide one matching plug conforming to MIL-C-24368/1 with each receptacle. Provide plug with factory potted 3/C type THOF-500 cable pigtail. Cable pigtail shall be a minimum of 3050 mm and shall conform to MIL-C-915/6. Turn plug assemblies over to the Contracting Officer.

2.26.3 Single-Pole Power Receptacles

Rated for 600 volts, 500 amperes, 60 hertz, single-pole, continuous duty operation. Receptacles shall be compatible with Duraline standard latching ball nose male plugs. Receptacle shall be angled 15 degree and be designed for mounting on a vertical plate and connecting a lugged cable via a threaded stud and hex jam nut. Receptacles shall be provided with protective cap attached via wirelon and shall be color coded red phase A, black phase B, and white phase C. Receptacles indicated with auxiliary switches shall have a thru-center plunger which activates a two circuit single-pole double-throw, water tight aluminum housed switch. The switch shall be electrically rated for 25,000 cycles at 450 volts, 2 amperes, 60 hertz, and shall be mechanically rated for 20,000,000 cycles.

2.26.4 Pushbutton Box

Provide two NEMA Q600 rated, 30 millimeter, heavy duty industrial type, normally-open, momentary, red pushbuttons, housed in a NEMA 4X device box with a spring return cover.

2.27 Remote Trip Pushbutton Panel

Provide two NEMA Q600 rated, 30 millimeter heavy duty industrial type, normally-open, momentary, red pushbuttons, housed in a NEMA 4X enclosure with a front hinged latching door.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Hazardous Locations

Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 6.35 mm in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 16 mm in diameter for low voltage lighting and power circuits.

3.1.3.1 Nonmetallic Conduit

Use nonmetallic conduit only where indicated.

3.1.3.2 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.3 Conduit for Circuits Rated Greater Than 600 Volts

Conduit for circuits rated greater than 600 volts shall be as specified in Section 16303, "Underground and Underpier Electrical Work".

3.1.4 Conduit Installation

Keep conduit minimum 150 mm away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits under floor slab as if exposed.

3.1.4.1 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 40 mm in reinforced concrete beams or to depth of more than 20 mm in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems must be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.4.2 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.3 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 890-N tensile strength. Leave minimum 915 mm of slack at each end of pull wire.

3.1.4.4 Telephone and Signal System Conduits

Install in accordance with specified requirements for conduit, and with additional requirement that no length of run shall contain more than two 1.57 rad bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits 27-mm trade size and larger shall be minimum five times nominal diameter. Terminate conduit in terminal cabinet with two locknuts and plastic bushing.

3.1.4.5 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.6 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in intermediate metal conduit (IMC).

3.1.4.7 Flexible Connections

Provide flexible steel conduit between 915 and 1830 mm in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 16 mm diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.4.8 Expansion Joints for Exposed PVC

Install in conduits where the conduits pass through structural expansion joints. An expansion joint with gasket shall be installed at least every 30.5 meters. For each run shorter than 30.5 meters provide at least one expansion joint.

3.1.5 Cable Tray Installation

Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support as indicated. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Edges, fittings, and hardware shall be finished free from burrs and sharp edges.

3.1.6 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 100 mm square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 610 mm from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.6.1 Boxes

Boxes for use with raceway systems shall be minimum 40 mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 100 mm square, except that 100- by 50-mm boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 100 mm square by 40 mm deep.

3.1.6.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide nonmetallic pull boxes where indicated. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6.3 Extension Rings

Extension rings shall not be used.

3.1.7 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 1980 mm above floor. Mount lighting switches 1220 mm above finished floor, receptacles 460 mm above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.8 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations.

3.1.9 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.10 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of .58 mm. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.11 Electrical Penetrations

Seal openings around electrical penetrations.

3.1.12 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.12.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.12.2 Telephone Service

Provide main telephone service equipment ground consisting of separate No. 6 AWG ground wire in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.13 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.14 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.14.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.14.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.14.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, as indicated.

3.1.14.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.1.15 Watthour Meters

ANSI C12.1.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Transformer Tests

Perform test classified as routine in accordance with NEMA ST 20 on each transformer.

3.2.4 GFI Receptacle Test

Test GFI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.2.6 Watthour Meter

a. Visual and mechanical inspection

(1) Examine for broken parts, shipping damage, and tightness of connections.

(2) Verify that meter type, scales, and connections are in accordance with approved shop drawings.

b. Electrical tests

(1) Determine accuracy of meter.

(2) Calibrate watthour meters to one-half percent.

(3) Verify that correct multiplier has been placed on face of meter, where applicable.

3.3 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
a. Cable tray		
- depth	4 inches	100 mm
- width	30 inches	760 mm
b. Cabinets, junction and pull boxes		
- volume	100 cubic inches	1640 mL
c. Device plates		
- thickness	0.03 inches	0.792 mm
d. Outlet boxes	2 by 4 by 1 1/2 inches	5 by 100 by 40 mm
e. Ground rod		
- diameter	3/4 inch	19 mm
- length	10 feet	3050 mm
f. Wireways		
- sizes	2 1/2 by 2 1/2 inches	63.5 by 63.5 mm
	4 by 4 inches	100 by 100 mm
	6 by 6 inches	150 by 150 mm
	8 by 8 inches	200 by 200 mm
	12 by 12 inches	305 by 305 mm

-- End of Section --

SECTION 16511

LIGHTING
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS2	(1985; R 1994 with Revisions thru 1994) Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits
ANSI C78.42	(1995) Electric Lamps - Guidelines for High-Pressure Sodium Lamps
ANSI C82.4	(1985; Supp. 1988) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C136.3	(1989) Roadway Lighting Equipment - Luminaire Attachments
ANSI C136.13	(1987) Roadway Lighting - Metal Brackets for Wood Poles
ANSI C136.10	(1996) Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ANSI C136.21	(1987; R 1992) Roadway Lighting - Vertical Tenons Used With Post-Top-Mounted Luminaires

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A36/A36M	(1997; Rev A) Carbon Structural Steel
ASTM A 123/A 123M	(1997; Rev A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 633/A633M	(1995) Normalized High-Strength Low-Alloy Structural Steel Plates

ASTM C 1089	(1989) Spun Cast Prestressed Concrete Poles

FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC-70/7460-1	(Rev. H) Obstruction Marking and Lighting
FAA AC-150/5345-43	(Rev. D) Obstruction Lighting Equipment

FEDERAL SPECIFICATION (FS)

FS RR-W-410D	(1984, Amend 1) Wire Rope and Strand

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	(1993) Lighting Handbook, Reference and Application

MILITARY SPECIFICATIONS (MIL)

MIL-L-7830	(Rev. D) Light Assembly, Marker, Aircraft Obstruction
MIL-W-83420	(Rev. E) Wire Rope, Flexible, for Aircraft Control

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LL 1	(1997) Procedure for Linear Fluorescent Lamp Sample Preparation and the TCLP

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code
NFPA 101	(1994) Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES INC. (UL)

UL 773	(1995; R 1998) Plug-In, Locking Type Photocontrols for Use With Area Lighting
UL 773A	(1995) Nonindustrial Photoelectric Switches for Lighting Control
UL 924	(1995; R 1995, Bul. 1995) Emergency Lighting and Power Equipment
UL 935	(1995, Bul. 1995) Fluorescent-Lamp Ballasts

UL 1029	(1994; R 1995) High-Intensity-Discharge Lamp Ballasts
UL 1570	(1995; R 1991, Bul. 1996) Fluorescent Lighting Fixtures
UL 1572	(1995; R 1997) High Intensity Discharge Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16403, "Electrical Distribution System." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.3.3 Year 2000 Compliant

Computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 16001, "Division 16 Submittal Reduction Procedures." Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.4.1 SD-01 Data

a. Training plan G

1.4.2 SD-02 Manufacturer's Catalog Data

a. Fluorescent lighting fixtures G

b. Fluorescent electronic ballasts G

c. Fluorescent electromagnetic ballasts G

d. Fluorescent lamps G

e. High-intensity-discharge (HID) lighting fixtures G

f. HID ballasts G

g. High-pressure sodium (HPS) lamps G

h. Lighting contactor G

i. Photocell switch G

j. Emergency lighting equipment G

k. Concrete poles G

l. Brackets

m. Steel Poles G

n. High-mast Lowering Device G

o. Obstruction light G

1.4.2.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers."

1.4.3 SD-04, Drawings

a. Luminaire drawings G

b. Poles G

1.4.3.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and candlepower distribution data shall accompany shop drawings.

1.4.3.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS2, pole deflection, pole class, high-mast lowering device, and other applicable information. For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.

1.4.4 SD-08 Statements

a. Year 2000 (Y2K) Compliance Warranty G

1.4.4.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.5 SD-10, Test Reports

a. Test Data for luminaires G

1.4.5.1 Test Data for luminaires

a. Computerized horizontal illumination levels in footcandles at ground level, taken every 6090 mm. Include average maintained footcandle level and maximum and minimum ratio.

b. Distribution data according to IES classification type as defined in IES LHBK.

1.4.6 SD-12 Field Test Reports

a. Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

1.4.7 SD-18 Records

a. Information card G

1.4.7.1 Information Card

For each electronic ballast manufacturer used in the construction, furnish a typewritten card, laminated in plastic. Card shall be 216 by 279 mm minimum and shall contain the information listed on Form 1 located at the end of this section. The card shall be turned over to the officer in charge of construction with warranty and equipment information. Send a photostatic paper copy to LANTNAVFACENGCOM, Code 1613, 1510 Gilbert Street, Norfolk, VA 23511-2699.

1.5 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Concrete Poles

Do not store poles on ground. Support poles so they are at least 304.8 mm above ground level and growing vegetation.

1.6.2 Steel Poles

Do not store poles on ground. Support poles so they are at least 305 m above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16303, "Underground and Underpier Electrical Work" and Section 16403, "Electrical Distribution System."

2.2 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems, lighting contactors, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.3 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.3.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, ANSI C62.11, and NFPA 70 unless specified otherwise. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast shall be UL listed Class P with a sound rating of "A."

f. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

g. Ballast shall operate in an instant start mode.

h. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.3.1.1 T-8 Lamp Ballast

a. Ballast shall be capable of starting and maintaining operation at a minimum of 10 degrees C for F32T8 lamps, unless otherwise indicated. When indicated, ballast shall be capable of starting and maintaining operation at a minimum of minus 17 degrees C for F32T8 lamps.

b. Total harmonic distortion (THD): Shall be 20 percent (maximum).

c. Input wattage.

(1) 62 watts (maximum) when operating two F32T8 lamps

2.3.2 Fluorescent Electromagnetic Ballasts

UL 935. Ballasts shall be high power factor type (0.9 minimum), unless indicated otherwise and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be Class P and shall have sound rating "A".

2.3.2.1 Electromagnetic Ballasts for Compact Fluorescent Lamps

Provide electromagnetic ballasts for compact fluorescent lamps.

2.3.2.2 Electromagnetic Low Temperature Ballasts

Provide fluorescent ballasts having a minimum starting temperature of minus 17 degrees C for lamps in fixtures mounted outdoors and in unheated buildings.

2.3.3 Fluorescent Lamps

a. T-8 rapid start, low mercury, lamps shall be rated 32 watts (maximum), nominal length of 48 inches, 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leaching Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

b. Compact fluorescent lamps shall be 3500 K, 10,000 hours average rated life, and as follows:

(1) T-4, twin tube, rated 13 watts, 825 initial lumens (minimum).

Average rated life is based on 3 hours operating per start.

2.3.4 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated.

2.4 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1572.

2.4.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.4.2 High-Pressure Sodium (HPS) Lamps

ANSI C78.42 wattage as indicated. 150 watt lamps, if required, shall be 55 volt type. HPS lamps shall have average rated life of 24,000 hours (minimum) for all higher wattage lamps.

2.5 OBSTRUCTION LIGHT

FAA AC-150/5345-43, Type L-810, or MIL-L-7830.

2.6 LIGHTING CONTACTOR

NEMA ICS 2, electrically held contactor. Contacts shall be rated for the connected voltage, for 30 amperes, and for the number of poles as indicated. Coils shall be rated for the connected voltage. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts. Provide contactor with hand-off-automatic selector switch.

2.7 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated for the voltage to which they are connected, 60 Hz with single-throw contacts. Switch shall be adjustable and turn on at or below 32 lux and off at 22 to 107 lux. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

a. integral to the luminaire where indicated, rated 1000 W minimum.

b. in a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ANSI C136.10, rated 1800 VA, minimum. Photocell shall be fixture mounted as indicated.

c. in a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.8 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated.

2.8.1 Emergency Lighting Unit

Provide as indicated.

2.9 Poles

Provide poles designed for wind loading of 161 km/hr determined in accordance with AASHTO LTS2 while supporting luminaires having effective projected areas indicated. Poles shall be embedded or anchor-base type as indicated, designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 65 mm by 130 mm. Handhole cover shall be secured by stainless steel captive screws.

2.9.1 CONCRETE POLES

Provide concrete poles conforming to ASTM C 1089. Cross-sectional shape shall be round.

2.9.1.1 Steel Reinforcing

Prestressed concrete pole shafts shall be reinforced with steel prestressing members. Design shall provide internal longitudinal loading by either pretensioning or post tensioning of longitudinal reinforcing members.

2.9.1.2 Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned between 60 to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

2.9.1.3 Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, reinforcing shall be protected with a vaporproof noncorrosive sleeve over the length without the 13 mm concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a nonmigrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

2.9.1.4 Strength Requirement

As an exception to the requirements of ASTM C 1089, poles shall be naturally cured to achieve a 28-day compressive strength of 48.23 MPa. Poles shall not be subjected to severe temperature changes during the curing period.

2.9.1.5 Shaft Preparation

Completed prestressed concrete pole shaft shall be clean, smooth, and free of surface voids and internal honeycombing.

2.9.2 Steel Poles

AASHTO LTS2. Provide steel poles for use with high mast lowering system having minimum yield strength of 379.2 MPa and hot-dipped galvanized in accordance with ASTM A 123/A 123M factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 344.7 MPa conforming to ASTM A36/A36M. Anchor bolts shall have a minimum yield of 344.7 MPa. Provide high-mast lowering devices as specified. Provide double obstruction lights on top of high-mast poles as indicated.

2.10 BRACKETS AND SUPPORTS

ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 31.75 mm galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 7320 mm above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.11 HIGH-MAST LOWERING DEVICE

Provide high-mast lowering device, lighting fixtures, and poles manufactured as an integrated system and provided and warranted by one manufacturer. The high-mast lowering device shall consist of three main sub-assemblies: headframe, lowering ring, and the clevis and wench. Provide one portable drive motor, for use on provided high-mast poles, to raise and lower the luminaire rings.

2.11.1 Headframe

The headframe shall consist of 3 hoisting sheave assemblies, a power cable roller assembly, 3 latch barrels, clevis assembly, and protective cover. Each sheave shall be zinc electroplated per ASTM A 633/A633M. Hoisting cables shall be 4.8 mm diameter, stainless steel aircraft cord, and shall meet MIL-W-83420 and FS RR-W-410D. The power cable roller assembly shall consist of multiple rollers providing a 180 mm bending radius for the cable. The latch barrel assemblies shall support the lighting fixture ring assembly when the lowering device is in its highest position, leaving the cables, clevis, and winch unloaded. Each latch barrel assembly shall be capable of supporting the entire weight of the ring and lighting fixtures independently of the other latch assemblies.

2.11.2 Ring

The luminaire ring shall consist of 3 latch pins, system status indicators, fixture mounting arms, and ring centering arms. The complete ring assembly shall be fabricated of hot dipped galvanized steel channel. The latch pins shall be stainless steel. During the unlatching sequence, the latch pins will transfer the load to the winch cable. The latching and unlatching shall be indicated by reflecting flags visible from the ground. The fixture mounting arms shall be fabricated of 50 mm galvanized steel tubing. The ring centering arms shall be designed to protect the pole, fixture, and lamps from damage while traversing the pole with winds up to 65 km/hr by utilizing continuous-contact spring-loaded iris-action guide arms with rollers. Interconnect arms to keep the pole in the center. The springs shall be stainless steel.

2.11.3 Winch and Clevis

A clevis assembly shall attach the winch cable to the 3 hoisting cables and the main electrical power cord. The clevis shall not allow either the winch cable or the hoist cables to independently rotate and shall have an ultimate breaking strength of at least 40,033 Newtons. The winch shall have an ultimate strength of at least 5 times the lifted load. It shall have a worm gear reduction with integral drag brake to prevent free spooling on the winch drum.

2.11.4 Portable Drive Motor

The portable drive motor shall weigh less than 20 kg nominal. It shall be a heavy duty reversing type and be sized according to the high mast system. Provide a 6 m minimum remote operating cord.

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

3.1.1 Emergency Lighting Units

Wire emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.1.2 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Set adjustable window slide for 11 lux minimum photocell turn-on.

3.1.3 Marking and Lighting of Airway Obstructions

Mark and light high-mast poles in accordance with FAA AC-70/7460-1.

3.1.3.1 Painting of Airway Obstructions

Patterns and colors to mark obstructions shall conform to FAA AC-70/7460-1 and be as indicated.

3.1.3.2 Obstruction Marker Lights

Install obstruction marker lights on high-mast poles with 25-mm zinc-coated rigid steel conduit stems using standard tees and elbows, except that where lowering devices are required, install in accordance with equipment manufacturer's recommendations.

3.2 INSTALLATION OF POLES

ANSI C2, NFPA 70, and to the requirements specified herein.

3.2.1 Concrete

Install according to pole manufacturer's instructions.

3.2.2 Steel

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 16303, "Underground and Underpier Electrical Work". Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

3.2.3 Pole Setting

Depth shall be as indicated. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 152 mm maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

3.2.4 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.3 GROUNDING

Ground noncurrent-carrying parts of equipment including luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 16303, "Underground and Underpier Electrical Work." Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.4 TRAINING

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor shall provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the high-mast lowering device system. Eight Government personnel shall receive training comparable to the equipment manufacturer's factory training. The duration of instruction shall be for not less than 4 hours for instruction of operating and maintenance personnel.

3.4.1 Instructor's Qualification Resume

Instructors shall be regular employees of the lowering device system manufacturer. The instruction personnel provided to satisfy the requirements above shall be factory certified by the related equipment manufacturer to provide instruction services. Submit the name and qualification resume of instructor to the Contracting Officer for approval.

3.4.2 Training Plan

Submit training plan 30 calendar days prior to training sessions. Training plan shall include scheduling, content, outline, and training material (handouts).

3.5 FIELD QUALITY CONTROL

The Contractor shall notify the Contracting Officer when the equipment is ready for final acceptance testing. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section. Test lowering device, lighting fixtures, and poles as an integrated system. Provide the services of a factory trained technician, regularly employed by the pole and lighting system manufacturer, for testing and balancing.

FORM 1, ELECTRONIC BALLAST WARRANTY

1. Location ______________________________ 2. Bldg. Name ____________________

3. Bldg. No. ______ 4. Installation Areas___________________________________

5. Contract No. _______________________

6. Ballast Manufacturer Name/Address ________________________

7. Exchange Information ____________________

8. Warranty Return Number: ____________________________

9. Warranty Period: From __________ To ___________

10. Acceptance Date: ______________ 11. Inspector: ____________________

12. Prime Contractor Name/Address: ____

Signature: _______________________________________ Date: ____________________

INSTRUCTIONS FOR FORM 1

1. Location: Name of activity as shown on contract.

2. Bldg. Name: As shown on contract or as provided by Contracting Officer.

3. Bldg. No.: As provided by Contracting Officer.

4. Installation Areas: Main areas in the building where ballasts are installed; floors, room numbers, lean-to, etc. A separate form is required for each ballast manufacturer used in the contract.

5. Contract No.: As shown on the contract.

6. Ballast Manufacturer Name/Address: Ballast manufacturer's name, address, and telephone number.

7. Exchange Information: Ballast exchange information such as point of contact, telephone number, shipping address if different from item 6, and any special shipping instructions.

8. Warranty Return Number: Return authorization number if required.

9. Warranty Period: Insert estimated start and end dates.

10. Acceptance Date: Show date ballasts were accepted by the Contracting Officer.

11. Inspector: Show Government inspector's name.

12. Prime Contractor Name/Address/Signature/Date: Shall be signed and dated by an official of the contracting firm.

-- End of Section --

SECTION 16712

PIER FIBER OPTICS DATA TRANSMISSION
12/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

ANSI/EIA/TIA-455-25A	(1989) Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies
ANSI/EIA/TIA-455-41A	(1993) Compressive Loading Resistance of Fiber Optic Cables
ANSI/EIA-4720000-A	(1993) Fiber Optic Cable
ANSI/EIA-472B000	(1985) Fiber Optic Communication Cables for Underground and Buried Use

SOCIETY OF MOTION PICTURE & TELEVISION ENGINEERS (SMPTE)

SMPTE 170M	(1994) Television - Composite Analog Video Signal - NTSC for Studio Applications

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02 Manufacturer's Catalog Data

a. FO Cable G

1.3.2 SD-11 Factory Test Report

a. FO cable reel test G

1.3.3 SD-12 Field Test Reports

a. Field test G

PART 2 PRODUCTS

2.1 FO CABLE

ANSI/EIA-4720000-A,ANSI/EIA-472B000. Cable shall be a single hybrid cable containing 12 single mode and 12 multimode fiber optic strands. Individual fiber conductors shall be color coded.

2.1.1 Multimode Fiber

Cable shall have all glass, graded index, dual window, fiber optic waveguide as conductors. Fiber shall have a nominal core diameter of 62.5 microns. Fiber shall be coated with a cladding material which is concentric with the core. Fiber cladding diameter shall nominally be 125 microns. Protect fiber with a protective tube, jacketed nonmetallic strength member, and exterior jacket. Numerical aperture of each optical fiber shall be a nominal of 0.275. Cable shall have transmission window centered at 850 and 1300 nanometer wavelengths. Attenuation at 850 nanometer wavelength shall not be greater than 3.5 db/km and at 1300 nanometers wavelength shall not be greater than 1.0 dB/km. Minimum bandwidth at 850 nanometer wavelength shall be 160 mhz-km and at 1300 nanometer wavelengths it shall be 500 MHz-km.

2.1.2 Single-Mode Fiber

Cable shall have all glass, dual window, fiber optic waveguides as conductors. Fiber conductor shall have a nominal core diameter of between 8 and 9 microns. Fiber shall be coated with a cladding material which is concentric with the core. Fiber cladding diameter shall nominally be 125 microns. Provide fiber with a protective tube, jacketed nonmetallic strength member, and exterior jacket. Cable shall have transmission window centered at 1310 and 1550 nanometer wavelengths. Outside cable attenuation at 1310 nanometers wavelength shall not be greater than 0.5 dB/km and at 1550 nanometer wavelength it shall not be greater than 0.4 db/km.

2.1.3 Cable Construction

Cable components shall withstand the environment where the cable is installed for a minimum of 20 years.

2.1.3.1 Mechanical Stress

Mechanical stress present in the cable shall not be transmitted to the optical fibers. FO cable shall be loose tube construction.

2.1.3.2 Protective Covering

Covering shall be flame retardant, moisture resistant, nonnutrient to fungus, ultraviolet light resistant, nontoxic, and electrically nonconductive. Cable shall be filled with electrically nonconductive flooding compound or shall use water absorbant tape.

2.1.3.3 Strength Members

Strength members shall be integral part of the cable construction. Provide nonmetallic strength member.

2.1.3.4 Cable Outer Jacket

Provide medium density polyethylene cable jacket. Jacket shall be flame retardant, moisture resistant, nonnutrient to fungus, ultraviolet light resistant, nontoxic, and electrically nonconductive.

2.1.3.5 Tensile Strength

Cables shall withstand an installation load of not less than 2700 Newtons and a long term tensile load of not less than 890 Newtons.

2.1.3.6 Impact and Crush Resistance

ANSI/EIA/TIA-455-25A, Table 2 for minimum impact energy for specified cable diameter. Minimum crush resistance of 220 Newtons per square centimeter, tested in accordance with ANSI/EIA/TIA-455-41A.

2.1.3.7 Operating Temperature Range

Minus 40 degrees C minimum and 70 degrees C maximum.

2.2 CONDUIT

Conduit as specified in Section 16303, "Underground and Underpier Electrical Work."

2.3 SOURCE QUALITY CONTROL

Contractor shall certify that FO cable conform to the requirements of this specification and ANSI/EIA-4720000-A.

2.3.1 FO Cable Reel Test

Test 100 percent of the fibers with an optical time domain reflectometer (OTDR) at 850 nanometers for multimode and 1310 nanometers for single mode fiber prior to shipment of the FO cable. Calibrate OTDR to show anomalies of 0.2 dB as a minimum. Submit photograph traces to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Install cable in accordance with the manufacturer's instructions, and ANSI C2.

3.1.1 Splices

Splices shall not be permitted.

3.2 FIELD QUALITY CONTROL

Furnish test equipment, instrumentation, personnel, and supplies necessary to perform all testing. Contracting Officer shall be given 5 working days notice prior to each test.

3.2.1 Field Test

Verify complete operation of data transmission system during field testing. Perform test on 100 percent of the fibers of each circuit and repeat from the opposite end of each circuit. Field tests shall include as a minimum:

a. Optical time domain reflectometer (OTDR) test at 850 nanometers for multimode and 1310 nanometer for single mode, of the FO cable on the reel prior to installation. Calibrate OTDR to show anomalies of 0.2 dB as a minimum. Submit photographs traces to the Contracting Officer.

b. After installation, repeat the OTDR test in item (a) above. Replace the cable that failed the test with new segment of cable. Test new segment of cable to demonstrate acceptability. Submit photographs traces for each circuit to the Contracting Officer.

c. Perform power attenuation test at light wavelength of the transmitter to be used on the circuit being tested. Measure flux at the FO receiver end and compare to the flux injected at the transmitter end. Provide a jumper at each end of the circuit under test to validate end connector loss. Rotational optimization of the connectors will not permitted. Circuit loss shall not exceed the calculated circuit loss by more than 2 dB. When test is unsatisfactory, examine circuit to determine the problem. Notify Contracting Officer of the problem and proposed procedures to eliminate the problem.

d. Perform continuous 24 hour bit error rate test on digital circuits. Bit error rate shall not exceed 1 bit in error out of each 1,000,000 bits sent for the test period. Test analog data circuits using a signal conforming to SMPTE 170M. Signal at the FO analog receiver output shall be analyzed on a waveform monitor or automated test set, shall be stable, and shall be as described in SMPTE 170M. When test is unsatisfactory, examine circuit to determine the problem. Notify Contracting Officer of the problem and proposed procedures to eliminate the problem.

-- End of Section --

SECTION 16721

TELEPHONE DISTRIBUTION SYSTEM
12/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI/ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA TSB40-A	(1994) Unshielded Twisted-Pair Connecting Hardware
EIA TSB67	(1995) Field Testing of Unshielded Twisted-Pair Cabling Systems
EIA/TIA-455-21A	(1988) FOTP-21 Mating Durability of Fiber Optic Interconnecting Devices
EIA/TIA-568-A	(1995; Addendum 1997) Commercial Building Telecommunications Cabling Standard
EIA/TIA-569-A	(1998) Telecommunications Pathways and Spaces
EIA/TIA-606	(1993) Telecommunications Infrastrutures of Commercial Buildings
EIA/TIA-607	(1994) Commercial Building Grounding and Bonding

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata #1) National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA 345-65	(1985) Shield Bonding Connectors (PE-33)
REA 345-67	(1987) Filled Telephone Cables (PE-39)
REA 345-72	(1985) Filled Splice Closures (PE-74)
REA 1755I-100	(1987) List of Materials Acceptable for Use on Telephone Systems of REA Borrowers

UNDERWRITERS LABORATORIES INC. (UL)

UL 83	(1996; Bul. 1997, R 1998) Thermoplastic-Insulated Wires and Cables
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514C	(1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 969	(1995; R 1998) Marking and Labeling Systems
UL 1863	(1995) Communications Circuit Accessories

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.4.1 SD-02 Manufacturer's Catalog Data

a. Wire and cable G

b. Cable splices, and connectors G

c. Closures G

d. Telephone receptacles G

e. T1 Receptacles G

f. Building protector assemblies G

g. Connector blocks G

h. Protector modules G

i. Main distribution frame G

1.4.2 SD-04 Drawings

a. Communication panels G

1.4.3 SD-06 Instructions

a. Installation procedures G

1.4.3.1 Installation Procedures

Where installation procedures, or any part thereof, are required to be in accordance with manufacturer's instructions, submit these instructions to the Contracting Officer prior to installation of the equipment.

1.4.4 SD-08 Statements

a. Cable splicer's qualifications G

b. Installer qualifications G

c. Test plan G

d. Year 2000 (Y2K) Compliance Warranty G

1.4.4.1 Cable Splicer's Qualifications

Submit for approval, 30 days before splices are to be made on the cable. Certification shall include the training, and experience of the individual on specific type and classification of cable to be provided under this contract.

1.4.4.2 Installer Qualifications

Prior to installation, submit data of installer's experience and qualifications which shall include 3 years on projects of similar complexity. Include names and locations of two projects successfully completed using fiber optic and copper communications cabling systems. Include written certification from users that systems have performed satisfactorily for not less than 18 months. Include specific experience in installing and testing structured telecommunications distribution systems using fiber optic and Category 3 cabling systems.

1.4.4.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP OFN components and accessories. Include procedures for certification, validation, and testing. Furnish factory reel tests for fiber optic cables.

1.4.4.4 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.5 SD-12 Field Test Reports

a. Pre-installation tests G

b. Acceptance tests G

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturer of such products and shall be the manufacturer's latest standard design.

2.2 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, telecommunications switches, surge protectors, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.3 MAIN DISTRIBUTION FRAME (MDF)

Provide a terminal cabinet as indicated

2.3.1 Building Protector Assemblies

Self-contained unit providing a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 400 pairs of outside cable. Building protector assembly shall have connector blocks for connection to provided cabling at full capacity.

2.3.1.1 Protector Modules

UL 497, REA TECM 823, three-electrode gas tube or solid state type rated for the application. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.3.2 Connector Blocks

Insulation displacement Type 66 for Category 3 systems. For communication panels provide B-Block Type with 50 rows each with 6-slot clips.

2.4 CLOSURES

2.4.1 Copper Conductor Closures

Underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured on encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Filled splice cases shall comply with REA 345-72.

2.5 COMMUNICATION PANELS (CP)

Shall include enclosure, connector blocks, receptacles, backboard, and nameplates as shown. The communications panel shall be a freestanding 9.525 mm thick welded stainless steel plate enclosure. Stainless steel shall conform to ASTM A 167. Assemblies shall be provided with lifting eyes. Metal work shall conform to requirements of Section 05500, "Metal Fabrications." Provide doors with a door latch mechanism having padlocking provisions.

2.5.1 Telephone Receptacles

Telephone outlet receptacles shall be as indicated. Provide receptacles with a matching weatherproof cap secured to the receptacle by a stainless steel wire or chain. Provide one matching plug assembly including backshell. Turn over to the Contracting Officer.

2.5.2 T1 Receptacles

Weatherproof male jack based on Bell Operating Company Specification CA08731. Jacks shall be mounted in weatherproof chrome plated brass hull inlets designed for flush mounting. Hull inlets shall be provided with gaskets. Jacks shall be Arrowhart catalog No. PH6623 or equal. Provide a matching connector with each jack. Hull inlet shall be Arrowhart catalog No. PH6594 or equal.

2.5.3 Nameplates

Provide laminated plastic nameplates at the receptacles as indicated.

2.5.4 Telephone and T1 Cable

Cable from connector blocks to receptacles shall be Category 5 telephone cable.

2.6 CABLE SPLICES, AND CONNECTORS

2.6.1 Copper Cable Splices

Splices shall consist of a moisture resistant, two- wire connector held rigidly in place to assure maximum continuity. Provide correct connector size to accommodate the cable gage of the supplied cable. Connector shall be listed in REA 1755I-100.

2.6.2 Connector

Splice connectors shall have polycarbonated body and cap with a tin-plated brass contact element. Connector shall accommodate 22 to 26 AWG solid wire with a maximum insulation diameter of 1.5 mm. Fill connector with sealant grease to make a moisture resistant connection, complying with REA 1755I-100.

2.6.3 Shield Connectors

Connectors shall make a stable, low-impedance electrical connection between the cable shield and the bonding conductor. Connector shall comply with REA 345-65.

2.7 CONDUIT

Provide in accordance to Section 16303, "Underground and Underpier Electrical Work."

2.8 PLASTIC INSULATING TAPE

UL 510.

2.9 WIRE AND CABLE

2.9.1 Telephone Cable (106 pair and higher)

Provide filled cable meeting the requirements of REA 345-67. Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Gage of conductor shall be 22 gage.

2.9.1.1 T-1 Rated Cable

Screen-compartmental core cable shall be filled cable meeting the requirements of REA 345-67 and must be T1 Rated (1.544 Mb/sec).

2.9.2 Fiber Optic Cable

Provide optical fibers in accordance with Section 16712, "Pier Fiber Optics Data Transmission."

2.9.3 Telephone Cable (under 106 pair)

NFPA 70, EIA TSB40-A, ANSI/ICEA S-80-576, EIA TSB67 and performance characteristics in EIA/TIA-568-A. Provide UTP, four-pair, 100 ohm. Provide four each individually twisted pair, 22 AWG conductors enclosed by an overall jacket. Individual pairs shall be constructed to contain a minimum two twists per 305 mm per each pair. Overall diameter of four pair cable shall not exceed 6.32 mm. Ultimate breaking strength shall be minimum 40.82 kg. Four pair cable shall withstand a bend radius of 25.4 mm minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking. Conductors shall be color coded and polarized in accordance with EIA/TIA-568-A. Cabling shall be Category 5. Provide a labeling system for cabling as required by EIA/TIA-606 and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.9.4 Grounding and Bonding Conductors

Solid bare copper wire meeting the requirements of ASTM B 1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B 8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.10 BACKBOARDS

Provide interior grade plywood 19 mm thick as indicated. Backboards shall be painted with a gray, nonconductive fire-resistant overcoat. Do not cover the fire stamp on the backboard.

2.11 TERMINAL CABINET

Construct of zinc-coated sheet steel sized as indicated. Trim shall be fitted with hinged door and locking latch. Doors shall be maximum size openings to box interiors. Boxes shall be provided with backboard. Provide label and identification system for telecommunications wiring consistent with EIA/TIA-606.

2.12 GROUNDING AND BONDING PRODUCTS

Comply with UL 467, EIA/TIA-607, and NFPA 70. Components shall be identified as required by EIA/TIA-606.

2.13 MISCELLANEOUS ITEMS

2.13.1 Cable Tags

Stainless steel, 41.25 mm in diameter 1.58 mm thick, and circular in shape.

2.13.2 Buried Warning and Identification Tape

Provide color, type and depth of tape as specified in paragraph "BURIED WARNING AND IDENTIFICATION TAPE" in Section 02315, "Excavation and Fill"

2.14 TELECOMMUNICATION OUTLET BOXES

Standard type 100 mm square by 55 mm deep. Surface mount at height indicated.

2.15 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

Jacks shall comply with EIA/TIA-568-A. Jacks shall accommodate UTP. UTP jacks shall be RJ-45 designation T568A type, UL 1863 listed, eight position, constructed of high impact rated thermoplastic housing rated for Category 5 service. Telecommunications cover plates shall comply with UL 514C, and EIA/TIA-568-A; oversized design constructed of high impact thermoplastic. Stenciled lettering for voice and data circuit shall be provided using thermal ink transfer process. Data jacks shall comply with EIA/TIA-455-21A for 500 mating cycles.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions and as shown. Provide all necessary interconnections, services, and adjustments required for a complete and operable telephone system. Installation shall be done in accordance with the safety requirements of ANSI C2, and NFPA 70.

Telecommunications cabling and pathway systems, and associated hardware shall be installed in accordance with EIA/TIA-568-A, EIA/TIA-569-A, NFPA 70, and UL standards as applicable.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Underground Duct

Underground duct shall be constructed as specified in Section 16303, "Underground and Underpier Electrical Work."

3.1.3 Cable Splicing

3.1.3.1 Copper Conductor Splices

Perform slicing in accordance with requirements of REA 345-6 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.4 Grounding

Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.4.1 Main Distribution Frame Ground Bar (MDFGB)

Provide cooper ground bar at the bottom of MDF for connection point for cable stub shields to connector blocks and MDF protector assemblies.

3.1.4.2 Incoming Cable Shields

Shields shall not be bonded a across the splice to the cable stubs. Ground shields of incoming cables in the MDF.

3.1.4.3 Main Distribution Frame Grounding

a. Protection assembles: Mound MDF protector assemblies directly on the vertical frame ironwork. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to MDFGB.

b. MGB connection: Connect MDFGB to the nearest ground connection point with No 6 AWG copper conductor with a total resistance of less than 0.01 ohms

3.2 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.2.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.2.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.2.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.2.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.2.2 Acceptance Tests

3.2.2.1 Telecommunications Cabling Field Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with EIA/TIA-568-A.

3.2.2.2 Inspection

Visual inspect cabling jacket materials for UL or third party certification markings. Visually inspect UTP and OFN jacket materials for UL or other certification markings. Inspect cabling terminations in telecommunications room and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with EIA/TIA-568-A. Visually confirm Category 3 markings.

3.2.2.3 Verification Test

Copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after terminated but not cross connected. Perform 16 mHz attenuation test for Category 3 systems installations.

Perform OFN testing using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures. Perform tests in accordance with EIA/TIA-526-14, Method B for horizontal, multimode OFN and EIA/TIA-526-7, Method B for backbone, single mode OFN. Perform in factory acceptance tests and factory reel tests at jobsite prior to installation.

3.2.2.4 Performance Tests

a. Category 3 Links. Test each pair for short circuitry continuity, short to ground, crosses, and reversed polarity. Include operational ringback, and dial tone tests.

3.2.2.5 Final Verification Tests

Perform verification tests for UTP and OFN systems after the complete telecommunications cabling and receptacles are installed. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.

3.2.2.6 Receptacles

Test for continuity through plug and receptacle assembly and for correct pair location on ship to shore cable compared to pigtail on receptacle.

-- End of Section --